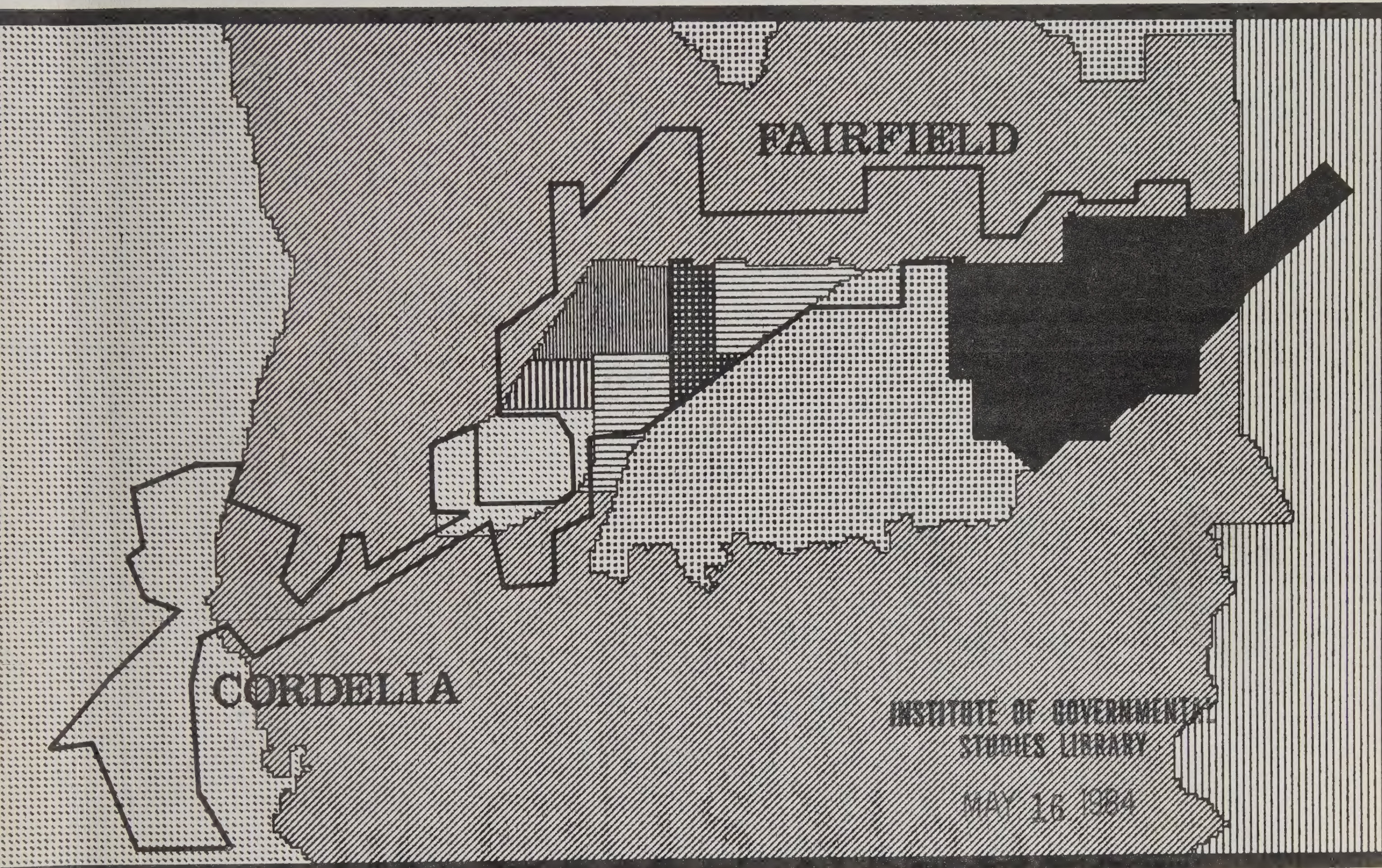
The CRIS Model

Cost Revenue Impact System

City of Fairfield, California



ABAG ASSOCIATION OF BAY AREA GOVERNMENTS / The City of Fairfield

C O V E R

The cover of this report is a map of the City of Fairfield depicting the Fairfield and Cordelia planning areas. This map was prepared on ABAG's computerized Bay Area Spatial Information System (BASIS). The patchwork areas show the census tracts in the Fairfield area. The shadings represent population density within each census tract as taken from the 1970 census of population. The shadings show population density within the tract; the darker the shade, the more dense the tract population.

F U N D I N G

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CITY OF FAIRFIELD, CALIFORNIA

October 1978

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Chapter I

INTRODUCTION

Background

In 1973, the City of Fairfield, California, applied for Federal assistance to construct a 10-12 million gallons per day (MGD) wastewater treatment facility. The project was designed to upgrade the existing level of wastewater treatment for Fairfield, Suisun City and Travis Air Force Base in conformance with the standards of the Regional Water Quality Control Board. The proposed sub-regional plant was expected to serve a vast new brewery and "Cordelia", a new community in the south west portion of the City. It was expected that Cordelia would have a population of 37,000 and employment for 8,000 basic industry workers. The sewage treatment plant was designed so that capacity could be added as the new community developed until the plant reached the full-scale capacity of 30 MGD.

In September 1973, the ABAG Executive Committee expressed its reluctance to approve the full-scale sizing of the facility until several concerns were resolved. Amon these concerns

was the desire to see a plan formulated for managing the Cordelia growth center as a bona fide new community. A method to stage growth was envisioned as part of this management plan. This staging of growth was seen as a method that would guard against fiscal imbalance and inequity in the delivery of municipal services.

In November 1973, the Department of Environmental Affairs of the City of Fairfield requested ABAG's assistance to "perfect Fairfield's management competence to maintain the form of the new Cordelia growth center". This request was followed by a formal proposal in January 1974, for the joint ABAG-City of Fairfield development of a system of analyzing the cost/revenue impacts of development proposals. After reviewing the merits of the proposal, ABAG approved a joint work program in February 1974.

The rapid growth of suburban communities over the 1950's and '60's caused unplanned impacts on the public service delivery and utility systems. Many communities began to deal with these impacts with traditional techniques (e.g., density controls and building moratoria). Others reached out for newer techniques that were destined to be reviewed by the courts (e.g., imposition of growth rates and "lids"). Sometimes these approaches were successful; sometimes not.

In this atmosphere, the City of Fairfield and ABAG began to explore management techniques that would assist in implementing a Cordelia general plan. In the context of Fairfield's overall community goals, it was decided that the development must be fiscally sound and not place undue strains on the existing public service systems. The development of a system of financial accounts to analyze the costs and revenues resulting from new urban development seemed appropriate for these objectives. Over the course of the work program, the system of financial accounts has acquired the general rubric of the "Cost Revenue Impact System" or simply, the "CRIS Model."

The CRIS Model is a computer system designed to measure the public costs of land development. It is a model because it attempts to replicate public decisions regarding the provision of urban facilities and services and predict the operating expenditures associated with this provision into the future. It measures the public costs through a variety of procedural techniques commonly refered to as fiscal impact analysis. As used here, fiscal impact analysis is the projection of the direct public costs and revenues associated with residential or nonresidential growth to the local jurisdictions in which this growth is occuring. Basically, then, the CRIS Model estimates the demand for new municipal services (including schools, streets, parks, sewers, etc.) and demands for increased service levels (including police, fire, recreation, domestic water, etc.) as a result of new residential and non-residential development.

The CRIS Model is designed to serve as a tool in planning by providing local decision-makers with estimates of the fiscal effects on the City budget (e.g., expenditures for municipal services, revenues from taxes and fees, etc.) of new development. Basically, this tool can be used in two ways--short-range budget analysis and long-range planning decisions.

- °In the short term (one to five years) the CRIS Model can be a valuable aid in projecting public service requirements and analyzing department budget request. The model can also predict the effect of proposed developments on public facilities, thereby allowing the City to program capital development and expansion.

- °In the long term (five to ten years), the CRIS Model can be used to predict the fiscal consequences of planning and policy patterns. In this way, the model can help to manage anticipated growth and bring development into closer harmony with the General Plan. CRIS can also form a link to integrate planning more directly with policy formation in the political process.

The CRIS Model can be an important tool for both the city planner and City Administrator. The primary purpose of CRIS is to measure impact of growth in terms of dollars of cost and revenue to the City. The model is capable of maintaining and providing valuable information on equipment

inventories, capital facilities, personnel requirements, and land constraints. The CRIS Model also can provide information concerning the relationship of costs and revenues for alternative development patterns and policy decisions.

The model cannot give the decision-maker information about the intrinsic "goodness" or "badness" of decisions. Developments which project a revenue/cost ratio of less than unity may still be considered desirable by other, noneconomic, goals or criteria. Thus, the CRIS Model is essentially a technique that must be used in an overall planning and decision-making context.

Fairfield History

Many settlers who came to California during the gold rush settled in the Fairfield area to raise fruit, sheep and cattle. In 1857, two of these settlers, Captain R. H. Waterman from Fairfield Connecticut and Mr. A. E. Ritchey, offered to give Solano County approximately 16 acres of land. The land was located north of what is now known as Suisun City. The gift, however, was conditioned upon County officials relocating the County seat to this site and calling it Fairfield. The County agreed. The town site was surveyed and the plot filed for record on May 16, 1959.

The completion of the railroad between Sacramento and Benicia in 1879 provided passenger service and shipping facilities to

the Fairfield area. Suisun City soon became a Southern Pacific Railroad freight division center. Later branch lines were extended to Vallejo and Napa.

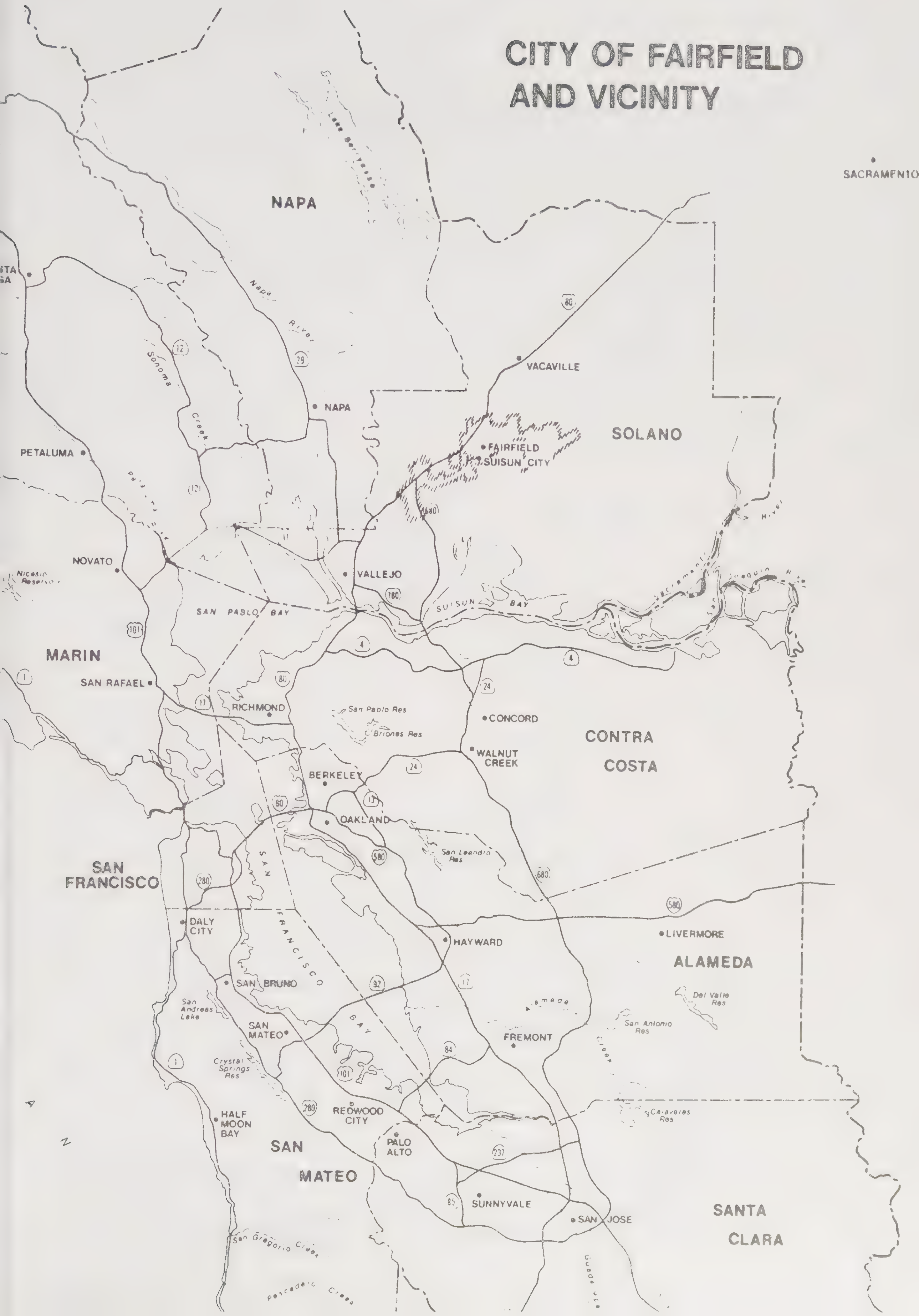
With the railroad playing a vital role in the community's growth, Fairfield and the surrounding area developed slowly and steadily as an agricultural center. On December 12, 1903, the City of Fairfield was incorporated.

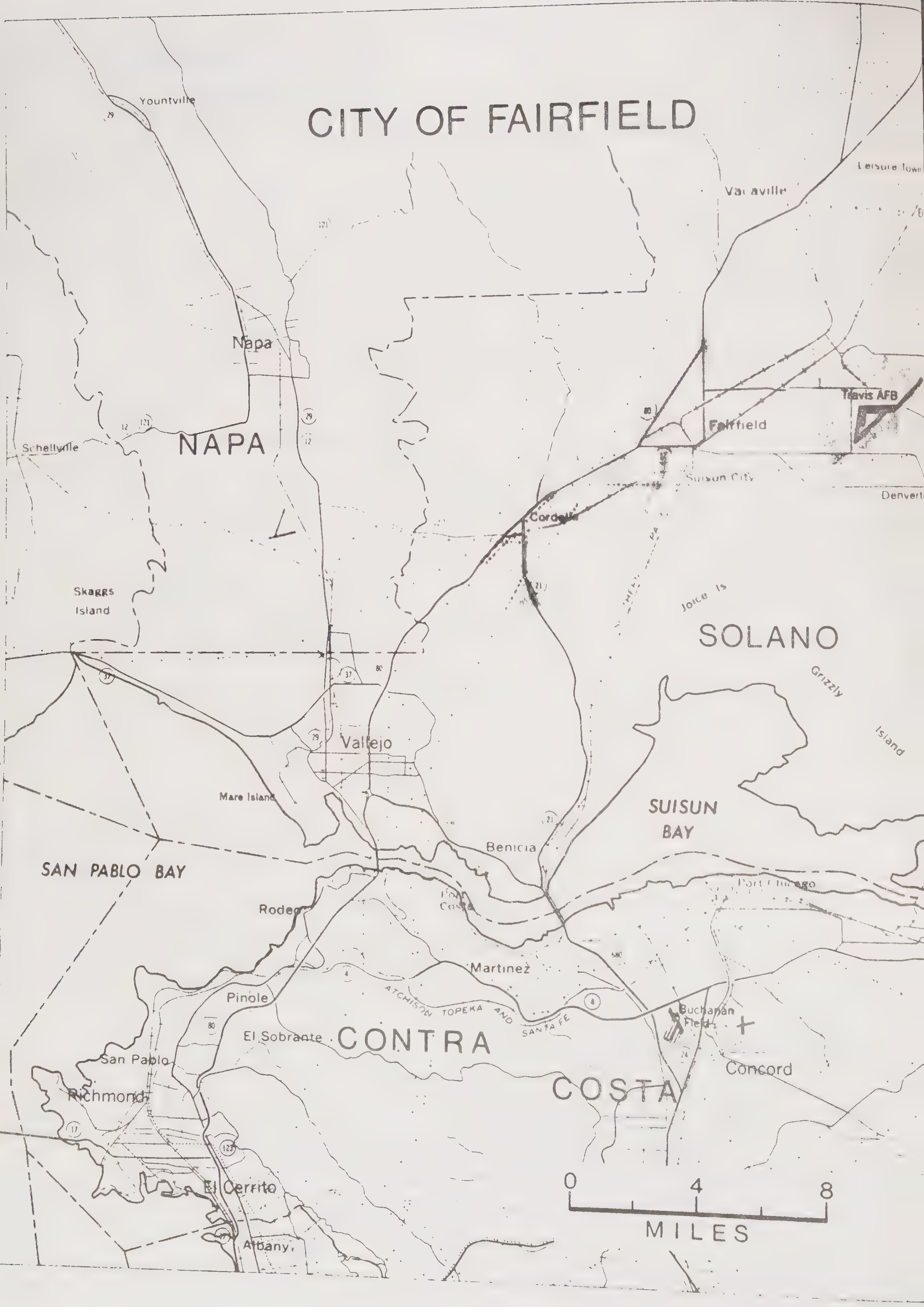
In 1943, the United States Air Force established an Air Transport Command base at Travis Air Force Base. The Air Transport Command was the predecessor of the present Military Air Transport Service (MATS). Since its establishment, Travis has steadily expanded in function and size. The growth of this base has led to a corresponding population growth in the City of Fairfield.

Fairfield Location

Fairfield is located on Interstate 80, midway between San Francisco and Sacramento (see map). The City is in central Solano County, part of the nine-county San Francisco Bay Area. The City of Suisun City, one of the oldest incorporated communities in the county, lies immediately to the south of the Fairfield City Limits.

Physically, Fairfield is a large city, encompassing more than 25 square miles. Yet the present city population uses only


CITY OF FAIRFIELD
AND VICINITY
SACRAMENTO
NAPA
Lake Berryessa
Napa River
SOLANO
VACAVILLE
NAPA
FAIRFIELD
SUISUN CITY
PETALUMA
Sonoma Creek
Petaluma River
NOVATO
Nicasio Reservoir
VALLEJO
SUISUN BAY
Sacramento River
San Joaquin River
SAN PABLO BAY
MARIN
SAN RAFAEL
RICHMOND
San Pablo Res
Briones Res
CONCORD
WALNUT CREEK
CONTRA
COSTA
BERKELEY
OAKLAND
San Leandro Res
SAN FRANCISCO
SAN FRANCISCO BAY
DALY CITY
HAYWARD
LIVERMORE
ALAMEDA
Del Valle Res
San Antonio Res
Alameda Creek
SAN BRUNO
San Andreas Lake
SAN MATEO
FREMONT
Crystal Springs Res
HALF MOON BAY
REDWOOD CITY
Calaveras Res
PALO ALTO
SAN
MATEO
SUNNYVALE
SAN JOSE
SANTA
CLARA
San Gregorio Creek
Pescadero Creek
Coyote Creek
N
80
12
29
121
37
780
680
4
101
1
17
24
13
580
280
92
84
237
85


CITY OF FAIRFIELD
Yountville
Vacaville
Leisure Town
Napa
NAPA
Schellville
Travis AFB
Fairfield
Suisun City
Denverton
Cordelia
Skaggs
Island
Joice Is
SOLANO
Grizzly
Island
Vallejo
Mare Island
SUISUN
BAY
Benicia
SAN PABLO BAY
Port Chicago
Rodeo
Martinez
Pinole
ATCHISON TOPEKA AND SANTA FE
Buchanan
Field
El Sobrante
CONTRA
San Pablo
Concord
Richmond
COSTA
El Cerrito
Albany
0
4
8
MILES

one-fourth of this area. At present, much of the city area is either part of the air base or undeveloped open space.

The population of Fairfield is about 54,000, but City officials anticipate the population will be approximately 80,000 to 90,000 by the 2000. In 1971, Fairfield annexed a 5.8 square mile area known as Cordelia. Much of Fairfield's anticipated growth is expected to occur in the Cordelia area.

Fairfield Government Organization

Fairfield is a general-law city with a Council/Manager form of government. The City provides municipal services -- police and fire protection, street maintenance, building inspection, and parks and recreation -- through functional city departments. Other services are provided by Solano County or by single-purpose special districts.

Fairfield is no longer considered a major agricultural center. The excellent highway and rail transport systems which once served the farms and ranches have made this an attractive area for industry. Most notable among the recent industrial developments is the Anheuser-Busch brewery.

Fairfield has its own municipal water system. The Fairfield-Suisun Sewer District has responsibility for treatment of the City's sewage. The Sewer District boundary is contiguous with the limits of Fairfield and Suisun City. The District is

governed by a ten-member board composed of the city council-members from both cities. The sewer plant itself is owned by the City of Fairfield and leased to and operated by the District.

The education of Fairfield school children is the responsibility of the Fairfield-Suisun Unified School District. Schools in the District cover grades K through 12. The boundaries of the School District extend beyond the incorporated limits of Fair-field and Suisun City to include extensive unincorporated areas of Solano County. The District is governed by an independently elected school board.

Chapter II

COST/REVENUE ANALYSIS

What is Cost/Revenue Analysis?

Most frequently and most simply, cost/revenue analysis or fiscal impact analysis is used to determine whether developments will generate sufficient new revenues in taxes to compensate for the added public services required.[1] But this is not the only purpose of cost/revenue analysis. Since cost/revenue analysis considers future revenues and the future mix or level of public services, it is most directly concerned with the future character of the community. Hence, if it is possible to estimate the costs associated with growth, it may further be possible to eliminate the common service discontinuities associated with growth.[2] This would allow the many public services which support both

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[1] Muller, Thomas, Fiscal Impacts of Land Development: A Critique of Methods and Review of Issues, Washington, D.C.: The Urban Institute, (1975), page 1.

[2] Burchell, Robert W. and Listoken, David, Fiscal Impact Analysis: American Association of Planning Officials, National Planning Conference (May 1978), page 1.

residential and non-residential development to be ready when they are needed. Indeed, it is through this ability to predict future demands for existing or new public services that cost/revenue or fiscal impact analysis may be most useful to local decision-makers.

It should be made clear, however, that cost/revenue analysis considers only the fiscal impact of land use decisions. It does not, like cost/benefit analysis, provide a framework for evaluating the effects of land use patterns on the general welfare.

There are several methods of estimating the costs and revenues for a particular operating system. All of these methods have inherent strengths and weaknesses. The following sections provide summary descriptions of the methods of technologies of cost/revenue analysis. Not all of these techniques were employed in the CRIS Model. The decision for the CRIS Model was to avoid reliance on any one method, but to use various methods where they were most useful. In some cases, a method was tried initially, but later rejected in favor of a more accurate or simpler methodology.

Estimates by Local Officials

Often local officials and department heads are able to project the cost of additional local services which are required as a result of new development. This method will often consider the marginal cost of development, including excess or deficient

capacity. Frequently, however, these estimates consider only short-term effects and immediate budget or staff needs. But the results of this type of techniques are difficult to confirm and, in retrospect, this type of cost/revenue analysis has not been particularly accurate or reliable.

Community Standards

New or increased public expenditures can be estimated on the basis of established community standards. Many cities have set per capita policies for the provision of various public services (e.g. number of police per thousand population, acres of open space per thousand population, number of library volumes per person). In other cases, service standards can be determined from census information. This method assumes that new residents will have the same characteristics and public service demands as the existing residents. The community standards method does not provide for demand shifts or changes in the public service preferences of the new increment of population.

Share Allocation

Share allocation is a method of estimating the additional expenditures for new residents on the basis of the present per capita cost of services. The anticipated new residents are assigned a share of the anticipated costs proportional to their share of the population. Again, this does not dis-

tinguish between new and current residents or the difference because of residents living in various types of development. But the per capita or share method is the most versatile and most frequently used method of fiscal impact analysis.

Accountants Approach

The accountants approach method involves the examination of annual budgets to determine the cost that can be attributed to new growth. The total cost of development is difficult to predict because this technique is not designed to estimate incremental costs. In addition, accuracy is limited because at least some costs may be aggregated or ignored.

Demographic Pattern

There is generally a strong association between the demographic characteristics of new residents and the type and size of housing units in a new development. Consequently, the service demands and, thus, the public expenditures for new residents can be estimated from the demographic characteristics of the expected new population.

Income Patterns

There is ample evidence that municipal revenues are closely related to the household income level. Therefore, the estimated income of new residents is an excellent proxy for the taxes resulting from new development.

Cross-Sectional Analysis

Cross-sectional analysis employs the use of aggregate level data, such as expenditures for services, by several communities that are grouped by size. Regression analysis is used on the cross-section of cities to see if there are significant relationships between per capita expenditures and their rate of growth.

Time-Series Analysis

Time-series analyses use data on variables at different points in time to determine the impact of growth across the period. For instance, expenditures for a particular municipal service can be compared for successive years. The accuracy of this analysis is frequently limited when population is the only independent variable. Another limitation in time-series analysis is that of autocorrelation; this year's expenditure for a service is related to last year's level of expenditure.

Econometric Models

Econometric methods use multivariate regression analysis and other techniques to determine relationships between several explanatory variables and expenditures for some particular service. A problem with reliance on this technique is that often there is no consistent and statistically significant pattern that emerges from the model.

Alternative Development Patterns

Many communities have sponsored studies that test different patterns of development to determine which will result in the lowest per capita cost of providing equivalent services. Development densities or other characteristics are varied to determine which alternative is associated with the lowest public service cost. Shortcomings of this method are (1) it often does not consider revenues, (2) differences between private and public costs may not be accounted, and (3) it frequently overlooks the annual maintenance costs.

What are the Limitations of Cost/Revenue Analysis?

Cost/revenue analysis is not a panacea for local planners. Each tenchique or method of cost/revenue analysis has idiosyncratic limitations. In addition, the general cost/revenue methodology has universal limitations which affect the whole field.

Geographical/Jurisdictional Limitations

All cost/revenue analysis must be delimited at some geographical or jurisdictional boundary. The analysis must be bounded by the fiscal system under consideration. Even the most careful and comprehensive cost/revenue analysis by a local government will fail to consider the fiscal impacts of development which extend beyond the city limits. For example, an analysis of the fiscal impacts of a regional shopping center, done in the context of one jurisdiction, will not measure

the impact or direct externalities on neighborhing jurisdictions. These communities may need to improve roads that will serve the shopping center or provide extra police services for traffic control. Moreover, the fiscal impact on other levels of government such as counties or special districts may be excluded from the evaluation.

Relative/Absolute Costs

Cost/revenue analysis predicts future fiscal impacts from anticipated development. However, this methodology cannot be used to predict future city or departmental budgets in absolute dollars of revenue and cost. Cost/revenue analysis is limited by the errors inherent in all predictions. Thus, the conclusions of cost/revenue analysis can only be seen as a relative rather than absolute measure of the fiscal impacts.

Non Fiscal Issues

Cost/revenue analysis considers only pecuniary costs and revenues. By definition, this type of analysis does not consider costs which do not or cannot have monetary values. A complete analysis of the impacts of a development must consider the nonpecuniary costs and benefits. For example, developments, of any type, may result in increased traffic congestion and noise. This can have the effect of reducing the quality of community life for all residents in a way which cannot be measured by the fiscal impact alone.

Ceteris *Paribus* Assumption

The assumption of "all other things being equal" is empirically constrained. But models require the *ceteris paribus* assumption for their construction because it is not possible to specify all variables. For example, municipal cost/revenue analyses generally assume that the levels or standards of public service will remain unchanged despite the community growth. However, as a community grows, the populace may demand new public services like public transportation, museums, or cultural centers. It is impossible for a fiscal impact model to forecast changes in public demands and compute the cost of new services.

Final Justification

Fiscal impact analysis is only one tool for the city administrator and planner. Special caution must be exercised that cost/revenue analysis does not become the sole or major determinant in the review of subdivision or development proposals. A development which yields a revenue/cost ratio of less than unity may still be considered desirable for a community using non-fiscal criteria. Similarly, a proposed development which expects to generate more public revenues than public costs should not be considered fiscally justified and approved *a priori*. Some communities may consider open space more valuable than the excess revenues generated by fiscally sound developments.

Some communities may approve a low-income housing development regardless of its fiscal consequences. Thus, cost/revenue analysis cannot be used by itself to determine the economic justification of proposed developments.

Chapter III

THE CRIS MODEL

onceptual Design of the CRIS Model

he CRIS Model is a specific application of cost-revenue ethodology to a local jurisdiction, the City of Fairfield. he model attempts to replicate the daily operations of the ity of Fairfield and report the costs and revenues associted with this activity.

he general discussion of cost/revenue analysis in Chapter II eviewed several categories of analytic methods that can be sed to assess the fiscal impact of community growth. The RIS Model does not use any one of these methods exclusively. n its attempt to model all municipal functions in Fairfield, he CRIS Model has to be extremely detailed and complex. Thus he model is actually a conglomeration of several methodologies, dopting each specific method as the model situation warrants he application of that technique.

he use of several methods of cost/revenue analysis in the CRIS odel was a conscious attempt to incorporate the strengths of

each technique to the specific estimation or projection situation involved. In addition, a particular method was used selectively to avoid the adoption of an estimation technique unsuited to the situation or so methodologically faulted that its use would have debilitated the general analysis. Thus, estimates by local officials were used with caution when other methods proved impractical. For instance, official estimates were employed to determine the need for additional or specialized, support fire fighting equipment as a result of anticipated development because fire deparment officials with a knowledge of the City were best able to make such a judgment.

The community standards method was used to estimate personnel or service requirements for the police and fire departments. However, established standards may not be consistently followed so, as with the method of timing the construction of fire substations, the standards were adjusted to bring them more in conformance with the observed procedures. This follows the generally accepted concept that departmental budgets provide an implicit standard of service level.

Several other cost/revenue analysis methods were employed in the CRIS Model. For instance, demographic and income pattern methods were used in the model to relate the demographic structure of the new population to household size and the income of the residents to the value of new dwelling units.

In concept the model has three sections: inputs, operating subsystems and output. A schematic diagram of the functional components in the CRIS Model is shown in Figure 1.

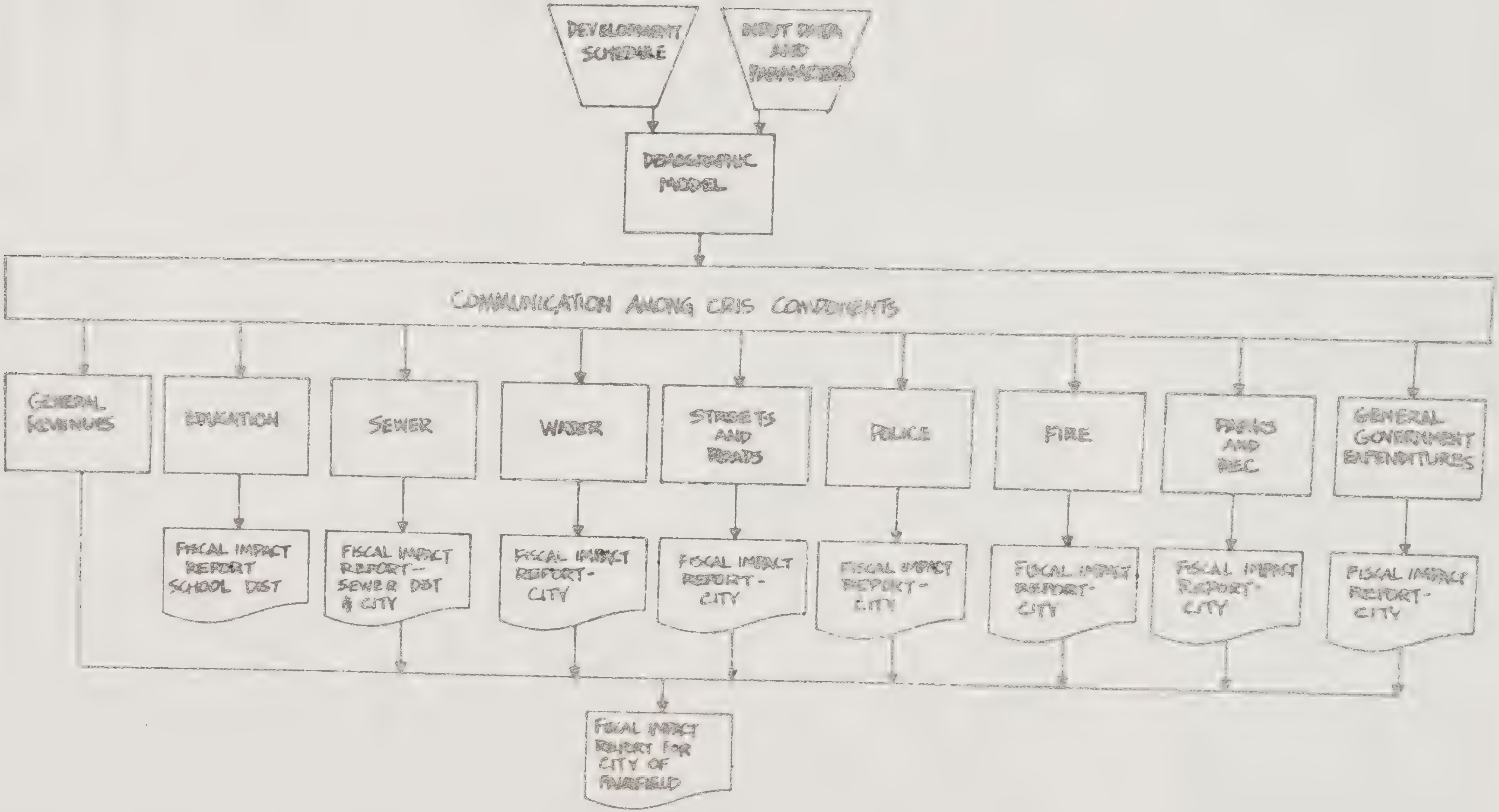
Input

The CRIS Model has two basic inputs: (1) schedules of development, and (2) base data and parameters. The primary input of the CRIS Model is the development schedules. The development schedule consists of annual information regarding the nature and extent of proposed construction. These schedules actually drive the model by providing the basic data required for the computations in each of the functional subsystems.

The CRIS Model disaggregates development schedules into three basic types: Residential, Commercial and Industrial (see Appendix A). Any number of each type of schedule includes information regarding the type of schedule, the year, the planning district, the sewer and water pipe required, the lane miles of streets, the square footage of the structures, the acreage of the total development, and an estimate of assessed value of the structures.

Much of this data is common to all three types of schedules. However, the development schedules also contain information which is specific to each type of development. For example, in the residential schedule, housing units are distinguished by multiple- and single-family residences. The housing units are further disaggregated into categories according to the number of bedrooms.

FIGURE 1
FUNCTIONAL COMPONENTS OF CRIS



Commercial development schedules distinguish between retail sales and office units. The commercial development schedules report the number of employees and sales estimates.

Industrial development is divided into light and heavy industry. During the general operation of the model only projected schedules of light industrial development are used. Heavy industrial development has major impacts on city service requirements and municipal revenues and, similarly, major impacts on the CRIS Model; thus, for general operations, each heavy industrial development is entered into the model by special user intervention.

Two items which the commercial and industrial development schedules have in common are the number of water meters (from which an estimate of water usage is made) and the expected sewer usage. These factors are included because of the variability in water and sewer usage that can occur between different types of establishments. For residential units, water and sewer usage is simply calculated using an average annual use per housing unit rate.

The information for the development schedules could be supplied by the local planning department, city manager, developer, consultant, or special interest groups. A unique schedule is prepared for each development. The information required for each

development schedule is shown in Table I. It should be stressed that each project, whether residential, commercial, or industrial, must be represented on a schedule. The total amount of development by planning area each year is aggregated from the schedules by the model. This allows the flexibility of making various combinations of schedules so that different development alternatives can be easily compared.

The second input to the CRIS Model is the base data and parameters. In order to project public service costs and local revenues to the end of any analysis period the model must have the initial values for the basic variables that are to be estimated. These base conditions include current inventories of equipment, personnel classificiations, school capacities and enrollment, and land use capability.

Input parameters are values which are assumed to remain constant during the projection period. For example, parameters would be the number of students per portable classroom, the number of sworn officers per 1,000 population, the fee schedule for construction permits, or the maintenance cost per foot of sewer line.

The Operating Subsystems

The functional components of the CRIS Model include several specific subsystems. Each operating subsystem represents the

Table 1

INFORMATION CONTAINED ON DEVELOPMENT SCHEDULES

Entry No.	Residential	Commercial	Industrial
1.	Type of Schedule	Type of Schedule	Type of Schedule
2.	Year	Year	Year
3.	SF Units 0-2 Bedrooms	(Retail Value)	Value (Light Industry)
4.	Average Value	Square Footage	Square Footage
5.	Square Footage	Acreage	Acreage
6.	SF Units 3 Bedrooms	Employees	Number of Structures
7.	Average Value	Sales (Gross)	Employees
8.	Square Footage	Sales (Taxable)	Value (Heavy Industry)
9.	SF Units 4+ Bedrooms	Number of Structures	Square Footage
10.	Average Value	(Office) Value	Acreage
11.	Square Footage	Square Footages	Number of Structures
12.	Total Acreage SF	Acreage	Employees
13.	MF Units 0-1 Bedroom	Employees	Lane Feet (1 Lane)
14.	Average Value	Sales (Gross)	Lane Feet (2 Lanes)
15.	Square Footage	Sales (Taxable)	Lane Feet (3 Lanes)
16.	MF Units 2 Bedrooms	Number of Structures	Lane Feet (4 Lanes)
17.	Average Value	Lane Feet (1 Lane)	Lane Feet of Oversizing (4 Lanes)
18.	Square Footage	Lane Feet (2 Lanes)	Lane Feet of Street Widening (4 Lanes)
19.	MF Units 3+ Bedrooms	Lane Feet (3 Lanes)	Sewer Pipe < 12" Diameter
20.	Average Value	Lane Feet (4 Lanes)	Sewer Pipe 12" Diameter
21.	Square Footage	Lane Feet of Oversizing (4 Lanes)	Sewer Pipe > 12" Diameter
22.	Total Structures	Lane Feet of Street Widening (4 Lanes)	Sewer Pipe Oversizing Fee
23.	Total Acreage MF	Sewer Pipe < 12" Diameter	Sewer Main Extension Charge
24.	Lane Feet (1 Lane)	Sewer Pipe 12" Diameter	Water Pipe < 12" Diameter
25.	Lane Feet (2 Lanes)	Sewer Pipe > 12" Diameter	Water Pipe 12" Diameter
26.	Lane Feet (3 Lanes)	Sewer Pipe Oversizing Fee	Water Pipe > 12" Diameter
27.	Lane Feet (4 Lanes)	Sewer Main Extension Charge	Water Pipe Oversizing Fee
28.	Lane Feet of Oversizing (4 Lanes)	Water Pipe < 12" Diameter	Water Main Extension Charge
29.	Lane Feet of Street Widening (4 Lanes)	Water Pipe 12" Diameter	Number of Water Meters
30.	Sewer Pipe < 12" Diameter	Water Pipe > 12" Diameter	Gallons Per Day of Sewer Use
31.	Sewer Pipe 12" Diameter	Water Pipe Oversizing Fee	Gallons Per Day of Water Use
32.	Sewer Pipe > 12" Diameter	Water Main Extension Charge	Storm Drain ≤ 36" Diameter
33.	Sewer Pipe Oversizing Fee	Number of Water Meters	Storm Drain > 36" Diameter
34.	Sewer Main Extension Charge	Gallons Per Day of Sewer Use	Pedestrian and Cycle Path
35.	Water Pipe < 12" Diameter	Gallons Per Day of Water Use	Planning District
36.	Water Pipe 12" Diameter	Storm Drain ≤ 36" Diameter	
37.	Water Pipe > 12" Diameter	Storm Drain > 36" Diameter	
38.	Water Pipe Oversizing Fee	Pedestrian and Cycle Path Footage	
39.	Water Main Extension Charge	Planning District	
40.	Storm Drain ≤ 36" Diameter		
41.	Storm Drain > 36" Diameter		
42.	Pedestrian and Cycle Path Footage		
43.	Planning District		

operations of a department of the Fairfield city government or a single-purpose special district. These governmental operations are expressed in a series of equations. The following sections provide a summary description of each subsystem shown in Figure 1.

Demographic Model

The demographic model is not, strictly speaking, a functional subsystem; it does not generate costs and revenues. However, it is included in the operations section because the demographic model uses the development schedules and base data in a manner similar to the operating subsystems. The primary function of the demographic model is to process housing units from the residential development schedules and provide estimates of population and school age children for use by the other subsystems.

General Revenues Subsystem

All revenues not accounted specifically within the other functional subsystems are calculated by the general revenue subsystems. Revenues from property taxes, construction fees, sales tax, State subventions and Federal grants and other revenues are estimated in this subsystem. User fees, library fines, and the sale or trade-in of used equipment are also accounted in the general revenue subsystem.

Education Subsystem

The education subsystem estimates the costs of education for students in the Fairfield-Suisun Unified School District.

Generally, these costs include: education costs, bus transportation, purchase of portable classrooms, and capital costs for new buildings. Also, since the School District is a separate legal entity with independent taxing authority, the school revenues, such as Federal and State aid and local school property tax, are estimated within this subsystem.

Sewer Subsystem

The sewer subsystem estimates increases in demand for sewage treatment as a result of development and determines if the capacity of the sewage plant needs to be expanded. The subsystem calculates the annual operation, maintenance, and capital costs for the Fairfield-Suisun Sewer District. Again, because the District is an independent political subdivision, the revenues from sewer connection and service charges are estimated in this subsystem.

Water Subsystem

This subsystem estimates the demand for water and determines if water treatment plants require expansion. The water subsystem estimates operating, maintenance, and capital costs of the City water department. The revenues from connection and use charges are estimated in this subsystem.

Streets and Roads

This subsystem accounts for the total lane miles of streets and roads in the City of Fairfield. The streets and roads

subsystem adds necessary personnel and equipment and calculates the operating costs involved in street maintenance.

Police Subsystem

This subsystem provides estimates of operating, maintenance, and capital costs incurred by the police department. The police subsystem also maintains an inventory of department equipment and staff.

Fire Subsystem

The fire subsystem estimates the need for and schedules the construction of new fire stations in the City. The subsystem estimates the costs of building and staffing the new stations as well as the annual operating cost for fire prevention and protection.

Parks and Recreation Subsystem

This subsystem estimates costs and revenues associated with maintenance of the City's parks and operation of the recreation programs. The subsystem also schedules the development of new parks and expansion of recreation opportunities.

General Government Subsystem

The costs not related to a specific subsystem are estimated in the general government subsystem. This subsystem includes the annual costs of the planning department, City Manager's office, the City Council, the city employee retirement fund, and general debt service.

Outputs

The output from the operation of the CRIS Model consists of (1) a summary report, and (2) a final report. The summary report is displayed at the terminal during the actual running of the model. The summary is primarily a graphic representation of the annual changes in key variables from each functional subsystem.

The statistics in the summary report are designed to aid the analyst in determining whether intervention in the model is warranted and where that intervention should be. In this way, the analyst can vary certain parameters of the model or characteristics of the proposed project to measure the effect of these assumptions or conditions on the projections for a specific subsystem. For example, the analyst could measure the changes in fiscal flows that result from a delay in proposed school construction or decision to build more multi-family than single family homes in a subdivision.

The ability to alter parameters is an important aspect of the CRIS Model. For instance, the education subsystem measures the capacity and enrollment of the school system and schedules the construction of new school facilities as they are required to accommodate the growing school population. However, because capacity and enrollment projections are made independently for the two planning areas, Fairfield and Cordelia, it

is possible that the model would schedule a capital investment for two new high schools in a single year. This would involve a relatively enormous single year capital cost for the School District (approximately $15.6 million). In reality, it is highly unlikely that the school board would commit the district to such an extraordinary capital expenditure in one year. In this case, the user of the CRIS Model could intervene to make an incremental adjustment in the parameter for high school capacity which would have the effect of delaying the construction of one of the schools to a later period.

The second form of output from the CRIS Model is a final report which contains the detailed costs and revenues for each subsystem along with demographic, personnel, capacity, and inventory statistics. The model can actually be run several times, with the user allowed to intervene frequently, before the final report is produced. The final report is designed to represent an annual city budget. When the user designates, the final report is printed on a line printer.

Operation of the CRIS Model

The CRIS Model is operated from a computer terminal using an interactive, question/answer, format. The analyst guides the operation of the model from a console. Figure 2 is a schematic diagram which depicts the operation of the CRIS Model. The operation proceeds in the following sequence of steps.

1. Load initial base variables and parameters for the subsystems. This can be accomplished outside the model by

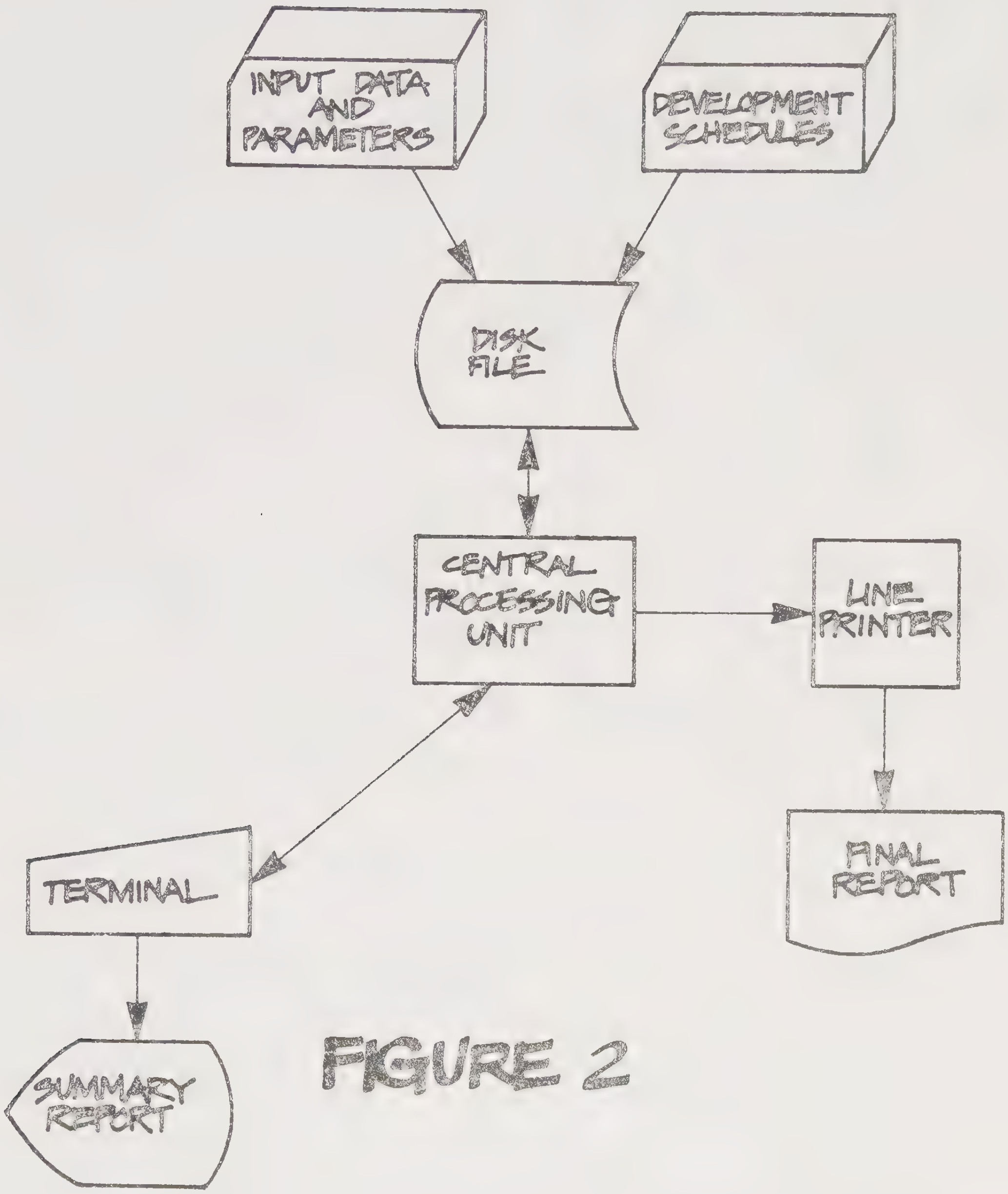

INPUT DATA AND PARAMETERS
DEVELOPMENT SCHEDULES
DISK FILE
CENTRAL PROCESSING UNIT
LINE PRINTER
FINAL REPORT
TERMINAL
SUMMARY REPORT

FIGURE 2

key punching the data and constructing an input file, or the data can be loaded from inside the model by entering from the terminal. A list of input data and parameters for each subsystem is shown in Appendix B.

2. Load in the development schedules and construct a machine-readable file. The development schedules may be prepared by the developer, planning department or any other department of the jurisdiction. Actually, a wide range of development schedules may be entered simultaneously. The CRIS Model has the ability to select from the set of schedules any combination or subset that the analyst wants to run for a particular development alternative. Sample development schedule forms appear in Appendix A.

3. Select the length of the projection period. The model is presently set to run projections for any period up to 20 years, however, the format of the final report is limited to a ten-year projection.

4. Determine the base variables or parameters to be changed, if any, before making the initial projection. The CRIS Model allows the analyst to change any input variable or parameter. These may be permanent changes to the data base or one-time changes just for this run only.

5. Select the combination or subset of development schedules to be run for current projection.

6. Run the model for the projection period selected.

7. When the CRIS Model terminates execution, it will display a summary report at the analyst's terminal. This report is primarily graphic and contains summary statistics such as the overall revenue/cost ration, capital expenditures by subsystem, and bonding capacity. The purpose of the summary report is to aid the analyst in deciding if a re-run or partial re-run of the model is desired.

8. If the analyst decides that the results are satisfactory skip steps 9 and 10.

9. If it is decided to re-run the model several options are available for intervention:

    a) return to the base year, submit a new combination of development schedules and re-run the model

    b) return to the base year, alter the input data or parameters and re-run the model

    c) select any year in the projection period, change the base data or parameters and re-run the model from that year forward.

10. After viewing the new summary report repeat step 9 if desired.

11. Request that final detailed report be printed. This report will be produced on the line printer.

12. Return to step 3 and run a new combination of development schedules or terminate the CRIS Model.

Chapter IV

THE DEMOGRAPHIC MODEL

Introduction

The demographic model is really a subsystem of the CRIS Model. Yet it has all the characteristics of a complete model; requires inputs, performs independent operations, and produces output which is used by the functional subsystems. Thus, the demographic system lies at the interface of the CRIS Model between the inputs to the functional subsystems and the subsystems themselves.

In the development of the CRIS Model it would have been possible to elimate the demographic model as a separate entity. A special demographic component could have been developed for each subsystem requiring such data. The several demographic components would have been unique to each subsystem because the particular requirements of the subsystems are so varied. However, the demographic model is responsible for computing and maintaining one of the most important inputs to the CRIS Model. It was

therefore considered most appropriate and most accurate to perform all demographic operations in a single subsystem or model so consistant methodologies could be employed.

DEMOGRAPHIC MODEL

The purpose of the CRIS demographic subsystem is to project annual population for the City of Fairfield. The subsystem also projects the school population of the Fairfield-Suisun Unified School District. These population projections are utilized by the other subsystems to compute costs and revenues within those systems.

In order to satisfy these purposes, the City of Fairfield and surrounding areas are geographically divided as shown in Figure 1:

1) City of Fairfield

Fairfield Planning Area (including Travis Air Force Base)

Cordelia Planning Area

2) Suisun City

GEOGRAPHIC DIVISIONS FOR CRIS

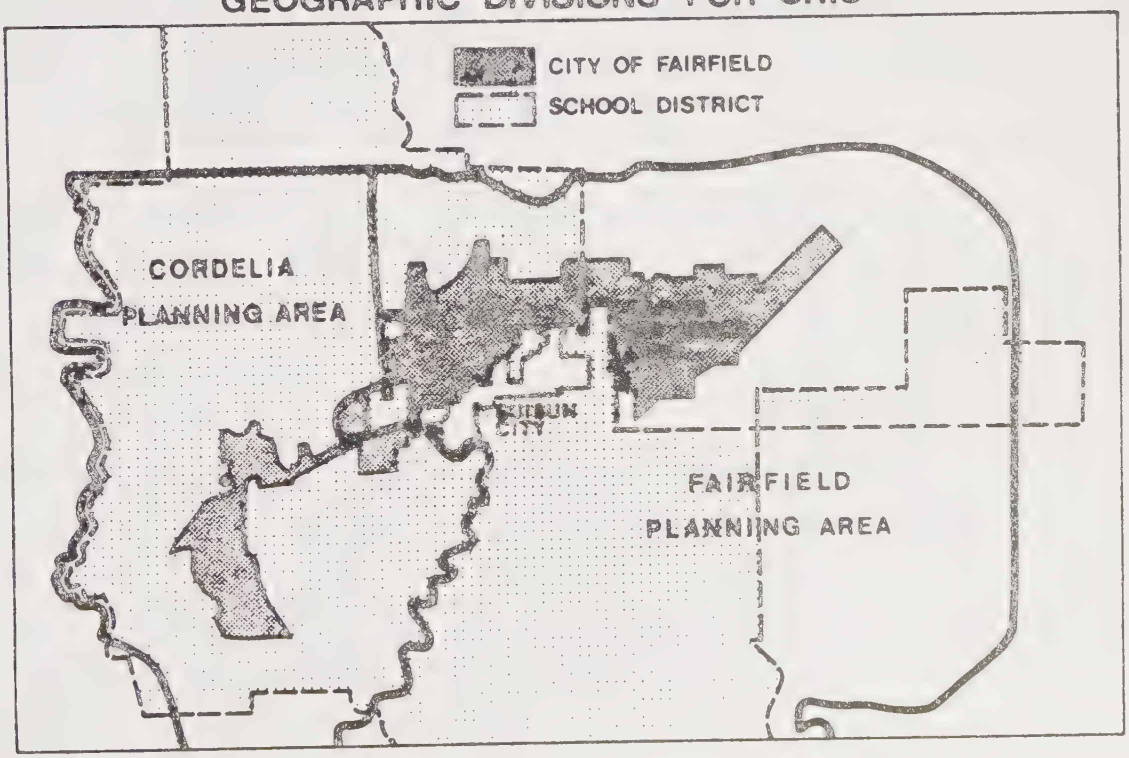


Figure D-1

The primary geographic areas of concern are the Fairfield and Cordelia planning areas. Most of the current population of the City is presently located in the Fairfield planning area. But the Cordelia planning area is where substantial new growth is expected.

Travis Air Force Base is located within the Fairfield city limits. Historically, the population of the air base has fluctuated approximately 70% in response to changes in overseas military activity. However, the current estimate is that the air base population will remain fairly constant at about 12,000. Thus, in the model, the population of the air base is set at 12,000, but this assumption can be easily modified.

In some calculations of the total population of the City of Fairfield, the population of the air base is included. For instance, Air Force personnel and their dependents are included in the computation of annual assistance from general revenue sharing. Under other circumstances it is appropriate to exclude the air base population because the municipal services required by the Travis residents (e.g., police and fire protection) are provided by the Air Force. For example, Travis has its own school system, consequently, the air base population is excluded from computations designed to estimate enrollment in the Fairfield-Suisun Unified School District.

The School District draws students from the Fairfield and

Cordelia planning areas and Suisun City as well as some unincorporated areas of Solano County (see map). For the purpose of estimating school population the model accounts for Suisun City and Solano County population as a separate entity. The demographic subsystem assumes the population of Suisun City will continue to increase at its historic growth rate. Solano County population growth estimates are derived from the ABAG Series 3 projections. However, either of these rates can be easily modified through user intervention.

The Modified Cohort Survival Method

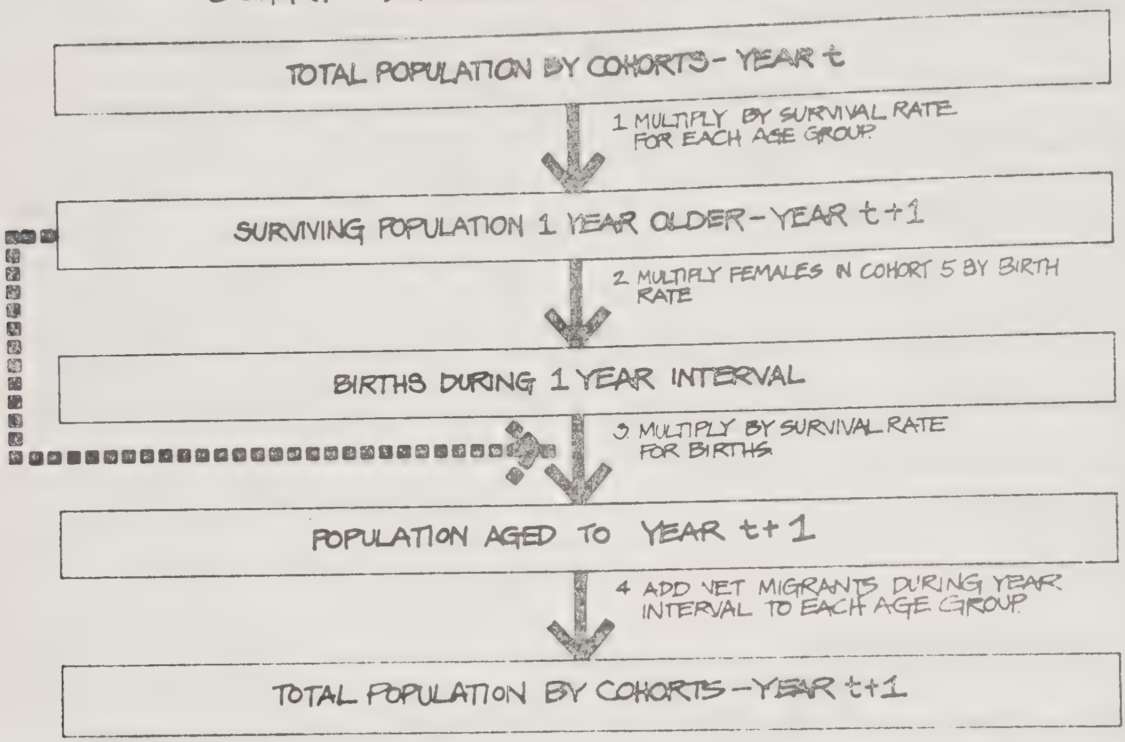
The demographic subsystem is a modified cohort-survival model. Basically, a cohort-survival method is a projection technique which recognizes three major components of population change: (1) decreases in population due to deaths, (2) increases in population resulting from births, and (3) increases and dedreases resulting from in- and out-migration.

As illustrated in Figure 2, the basic procedure begins with a base year population (e.g., 1970) broken down into age groups (0,1,2, etc.).

In step 1, the population in each age group (cohort) is moved one year forward in time by multiplying the number of people in the age group by the probability of surviving to the next year (e.g., the population which is one year old in 1970 is "survived"

FIGURE D-2

COHORT - SURVIVAL METHOD OF FORECASTING



to age 1 in 1971). This step determines the number of survivors in each age group one year in the future for ages 1 and above. The next step is to calculate the number of births during the one-year period. Births are derived by multiplying the number of women in the child bearing age group by the probability of a woman in that age group bearing a child. In step 3, the births are multiplied by the probability of surviving to the end of the interval (1971) in order to derive the number of children aged less than one at the end of the interval.

Normally a cohort-survival model will project population in specific and matched cohorts and time increments. Thus, a model would project a five-year population cohort for five

years or a one-year cohort annually. However, the particular requirements of the CRIS Model suggested a modified cohort-survival system. The demographic subsystem does not project cohorts which are matched to time intervals. The subsystem estimates total population annually but the cohorts are determined by the specific requirements of the education subsystem which must calculate enrollment by school grade level (see Table D-1).

The CRIS Model disaggregates the age of the population into five categories. The categories, determined by the need within the education subsystem to calculate the number of students in each grade level, are identified in Table D-1 below.

TABLE D-1

Demographic Subsystem Age Categories

Cohort	Age Group	School Grade
1	0-4	
2	5-12	K-6
3	13-14	7-8
4	15-18	9-12
5	19+	

There is a great deal of uncertainty surrounding migration assumptions at county, regional and state levels and even more so at the small area level like Fairfield. In order to deal with migration in the demographic subsystem, the following

assumptions are used:

1) net migration is a function of housing unit change, i.e., new population results from households occupying new units;
2) the demographic structure of current residents is in a state of dynamic equilibrium, i.e., if a household of a certain age composition moves from Fairfield, it is replaced by a household of the same age characteristics so that the demographic structure remains stable; and
3) no inter-migration is assumed to occur among the two planning areas, i.e., once a household occupies a unit in an area, they do not migrate to the other planning area. In fact, however, it is assumed that migrating residents are replaced by families with similar demographic characteristics within each area.

Assumptions 2 and 3 may prove to be too restrictive on a long run basis but are reasonable for short projection periods. These assumptions can be modified, for any or all projection periods, by intervention by the user. It should be recognized that the demographic subsystem is an accounting technique which projects population based on certain assumptions. The subsystem can only predict possible future conditions based on the assumptions chosen.

Because of the first assumption, the quantity of both type and

size of housing units dictates the size and age distribution of the new population. It is assumed that through time the people who move into the new housing units will have a constant age cohort profile of new movers by structure type and number of bedrooms based on the 1970 Public Use Sample for the area.

Projecting Current Population

The first operation in the CRIS demographic subsystem is to survive the current population of the Fairfield planning area (FPOP). The survival operation is performed for each cohort in equations D-1 through D-5. Here the existing population from the previous period t is summed with the new population (NPOPF) from the same period. This new population represents the population that migrated into the planning area during the period (from equations D-49 through D-53).

The total current population is multiplied by the survival rate to provide an estimate of the number of current residents for each cohort who will survive from period t to period t+1. The survival rate (SURV), specific for each cohort, was obtained from the California Department of Finance and based on the current State life table.

$$FPOP_{5,t+1} = (FPOP_{5,t} + NPOPF_{5,t}) * SURV_{5,p} \qquad (D-1)$$

$$FPOP_{4,t+1} = (FPOP_{4,t} + NPOPF_{4,t}) * SURV_{4,p} \qquad (D-2)$$

$$FPOP_{3,t+1} = (FPOP_{3,t} + NPOPF_{3,t}) * SURV_{3,p} \qquad (D-3)$$

$$FPOP_{2,t+1} = (FPOP_{2,t} + NPOPF_{2,t}) * SURV_{2,p} \qquad (D-4)$$

$$FPOP_{1,t+1} = (FPOP_{1,t} + NPOPF_{1,t}) * SURV_{1,p} \qquad (D-5)$$

The same operation is performed for the current population of the Cordelia planning area (CPOP). The new residents to the Cordelia planning area (NPOPC) are taken from equations D-55 through D-59. Again, each age cohort is survived by the cohort specific survival rate developed from the current State life tables.

$$CPOP_{5,t+1} = (CPOP_{5,t} + NPOPC_{5,t}) * SURV_{5,p} \quad (D-6)$$

$$CPOP_{4,t+1} = (CPOP_{4,t} + NPOPC_{4,t}) * SURV_{4,p} \quad (D-7)$$

$$CPOP_{3,t+1} = (CPOP_{3,t} + NPOPC_{3,t}) * SURV_{3,p} \quad (D-8)$$

$$CPOP_{2,t+1} = (CPOP_{2,t} + NPOPC_{2,t}) * SURV_{2,p} \quad (D-9)$$

$$CPOP_{1,t+1} = (CPOP_{1,t} + NPOPC_{1,t}) * SURV_{1,p} \quad (D-10)$$

The next operation is to advance each of the population cohorts by one age increment. In the general case (age cohorts 2 through 5) the operation is fairly simple. For example, the survived population in cohort 5 is aged by summing the survived population in the fifth cohort and a one year increment of the survived population from the fourth cohort. For the projection it is assumed that the population of the fourth cohort is evenly distributed by age in the cohort. The prime superscript following mnemonic indicates that the population in that cohort has been aged for that time period.

To age the population in the first cohort the CRIB Model must add to that cohort's survived population a projection of the number of births in that time period. The births are projected

by multiplying the percentage of females in population cohort 5 times the population in that cohort and then multiplying this product times the fertility rate measured in births per 1,000 females. Because of the higher mortality rate during the first year after birth, an infant survival rate ($SURV_I$) must be applied to the birth estimate. The fertility rate for Fairfield was obtained from the California Department of Finance fertility rate estimate for Solano County.

Demographers normally compute the fertility rate for females between the ages of 15 and 44. For the CRIS Model the DOF fertility rate was modified to provide an estimate of the number of births when using the female population cohort that is over the age of 18. The following equations, D-11 through D-15, age the current population of the Fairfield planning area. In equation D-15, FERT is the parametric fertility rate and $F/FPOP_5$ is the ratio of females in population category 5.

$$FPOP'_{5,t+1} = FPOP_{5,t+1} + .25\ FPOP_{4,t+1} \qquad \text{(D-11)}$$

$$FPOP'_{4,t+1} = .75\ FPOP_{4,t+1} + .50\ FPOP_{3,t+1} \qquad \text{(D-12)}$$

$$FPOP'_{3,t+1} = .50\ FPOP_{3,t+1} + .125\ FPOP_{2,t+1} \qquad \text{(D-13)}$$

$$FPOP'_{2,t+1} = .875\ FPOP_{2,t+1} + .20\ FPOP_{1,t+1} \qquad \text{(D-14)}$$

$$FPOP'_{1,t+1} = .80\ FPOP_{1,t+1} + FPOP_{5,t+1} * F/FPOP_{5,t} * FERT_p * SURV_{I,p} \qquad \text{(D-15)}$$

Equations D-16 through D-20 age the current population of the Cordelia planning area. Equation D-20 uses the same fertility rate (FERT) developed for the Fairfield planning area.

$$CPOP'_{5,t+1} = CPOP_{5,t+1} + .25\ CPOP_{4,t+1} \quad \text{(D-16)}$$

$$CPOP'_{4,t+1} = .75\ CPOP_{4,t+1} + .50\ CPOP_{3,t+1} \quad \text{(D-17)}$$

$$CPOP'_{3,t+1} = .50\ CPOP_{3,t+1} + .125\ CPOP_{2,t+1} \quad \text{(D-18)}$$

$$CPOP'_{2,t+1} = .875\ CPOP_{2,t+1} + .20\ CPOP_{1,t+1} \quad \text{(D-19)}$$

$$CPOP'_{1,t+1} = .80\ CPOP_{1,t+1} + CPOP_{5,t+1} * F/CPOP_{5,t} * FERT_{p} * SURV_{I,p} \quad \text{(D-20)}$$

Equation D-21 calculates the total current population for the Fairfield planning area (FTOT) as the sum of the population in each of the five age categories (D-11 through D-15).

$$FTOT'_{t+1} = FPOP'_{5,t+1} + FPOP'_{4,t+1} + FPOP'_{3,t+1} + FPOP'_{2,t+1} + FPOP'_{1,t+1} \quad \text{(D-21)}$$

The total current population for the Cordelia planning area (CTOT) is computed in equation D-22 by summing across all cohorts of current population.

$$CTOT'_{t+1} = CPOP'_{5,t+1} + CPOP'_{4,t+1} + CPOP'_{3,t+1} + CPOP'_{2,t+1} + CPOP'_{1,t+1} \quad \text{(D-22)}$$

Equation D-23 calculates the total current population of the City of Fairfield exclusive of the residents of Travis Air Force Base (TOTFF). The total population is simply the sum of the populations in each planning area.

$$TOTFF'_{t+1} = FTOT'_{t+1} + CTOT'_{t+1} \quad \text{(D-23)}$$

The population of the City of Fairfield including the air base (TOTFT) is calculated as the sum of the current population from

the Fairfield and Cordelia planning areas (D-21 and D-22) and the parameter representing the population of the air base. This calculation is performed in equation D-24 where TRAVIS is the population of the air force base.

$$TOTFT'_{t+1} = FTOT'_{t+1} + CTOT'_{t+1} + TRAVIS_p \qquad (D-24)$$

Projecting New Population

The CRIS demographic subsystem projects new (in-migrating) residents as a result of the development of new housing units and births to the new residents each year. The model computes the new residents for each of the planning areas (Fairfield and Cordelia) separately. It should be noted that, in the model, the new residents in the Fairfield and Cordelia planning areas are the direct result of the development of new housing units. Thus, the new residents are distinguished from the current residents of each planning area for the first period. In the second period, new residents are included with the current residents of their respective planning areas (equations D-1 through D-5 and D-6 through D-10).

New population in both the Fairfield and Cordelia planning areas is "created" as a result of vacant new housing units becoming occupied. Therefore, the first step in predicting the new population is to determine the number of housing units in the Fairfield planning area (ΔHUF) and in the Cordelia planning area (ΔHUC) which were occupied during the current period.

The CRIS Model divides housing units into six categories determined by the type of housing unit (i.e., single-family or multi-family) and the number of bedrooms contained within that housing type. The six housing categories are outlined in Table D-2

TABLE D-2

Housing Categories

Housing Category	Housing Type	Number of Bedrooms
1	Single Family	2
2	Single Family	3
3	Single Family	4+
4	Multi-Family	0-1
5	Multi-Family	2
6	Multi-Family	3+

Equations D-25 through D-30 calculate the number of newly occupied housing units in the Fairfield planning area (HUF) as the sum of the vacant housing units in Fairfield from the previous period (TEMPHF) and a portion of the newly constructed housing units in Fairfield (HUTF).

Rarely is a newly constructed unit occupied immediately upon completion. Given an annual building program, a certain proportion of the units completed during the current period will be vacant at the end of the period. Thus, the newly constructed units are reduced by a vacancy rate to determine only those units

that are both constructed and occupied in a single year. These vacancy rates were provided by Fairfield officials from historic data. Separate vacancy rates are employed for single and multi-family units. During any year (t+1) it is assumed that the vacant units from the previous period (t) are occupied first. This is represented by the mnemonic TEMPHF. The units constructed but not occupied in period t+1 are held into the following period (t+2). In the following equations the first subscripted number indicates the housing category.

$$\Delta HUF_{1,t+1} = TEMPHF_{1,t} + (HUTF_{1,t+1} * (1 - VRATE_{1,p})) \quad \text{(D-25)}$$
$$\Delta HUF_{2,t+1} = TEMPHF_{2,t} + (HUTF_{2,t+1} * (1 - VRATE_{2,p})) \quad \text{(D-26)}$$
$$\Delta HUF_{3,t+1} = TEMPHF_{3,t} + (HUTF_{3,t+1} * (1 - VRATE_{3,p})) \quad \text{(D-27)}$$
$$\Delta HUF_{4,t+1} = TEMPHF_{4,t} + (HUTF_{4,t+1} * (1 - VRATE_{4,p})) \quad \text{(D-28)}$$
$$\Delta HUF_{5,t+1} = TEMPHF_{5,t} + (HUTF_{5,t+1} * (1 - VRATE_{5,p})) \quad \text{(D-29)}$$
$$\Delta HUF_{6,t+1} = TEMPHF_{6,t} + (HUTF_{6,t+1} * (1 - VRATE_{6,p})) \quad \text{(D-30)}$$

The newly occupied housing units in the Cordelia planning area (ΔHUC) are computed by the same method. Again it is assumed that vacant housing units from the previous period (TEMPHC) are occupied first and that not all of the newly constructed units (HUTC) will be occupied in the year of their construction. Equations D-31 through D-36 compute the newly occupied housing units, by category, for the Cordelia planning area.

$$\Delta HUC_{1,t+1} = TEMPHC_{1,t} + (HUTC_{1,t+1} * (1 - VRATE_{1,p})) \quad \text{(D-31)}$$
$$\Delta HUC_{2,t+1} = TEMPHC_{2,t} + (HUTC_{2,t+1} * (1 - VRATE_{2,p})) \quad \text{(D-32)}$$
$$\Delta HUC_{3,t+1} = TEMPHC_{3,t} + (HUTC_{3,t+1} * (1 - VRATE_{3,p})) \quad \text{(D-33)}$$

$$\Delta HUC_{4,t+1} = TEMPHC_{4,t} + (HUTC_{4,t+1} * (1 - VRATE_{4,p})) \quad (D-34)$$

$$\Delta HUC_{5,t+1} = TEMPHC_{5,t} + (HUTC_{5,t+1} * (1 - VRATE_{5,p})) \quad (D-35)$$

$$\Delta HUC_{6,t+1} = TEMPHC_{6,t} + (HUTC_{6,t+1} * (1 - VRATE_{6,p})) \quad (D-36)$$

For each period the model calculates the number of available but unoccupied housing units to be held until the following period. For the Fairfield planning area the number of unoccupied housing units (TEMPHF) is obtained by muliplying the number of units constructed (HUTF) times the parametric unit-specific vacancy rate. Equations D-37 through D-42 calculate the unoccupied housing units for the Fairfield plannig area and equations D-43 through D-48 calculate the unoccupied housing units in the Cordelia planning area (TEMPHC).

$$TEMPHF_{1,t+1} = HUTF_{1,t+1} * VRATE_{1,p} \quad (D-37)$$

$$TEMPHF_{2,t+1} = HUTF_{2,t+1} * VRATE_{2,p} \quad (D-38)$$

$$TEMPHF_{3,t+1} = HUTF_{3,t+1} * VRATE_{3,p} \quad (D-39)$$

$$TEMPHF_{4,t+1} = HUTF_{4,t+1} * VRATE_{4,p} \quad (D-40)$$

$$TEMPHF_{5,t+1} = HUTF_{5,t+1} * VRATE_{5,p} \quad (D-41)$$

$$TEMPHF_{6,t+1} = HUTF_{6,t+1} * VRATE_{6,p} \quad (D-42)$$

$$TEMPHC_{1,t+1} = HUTC_{1,t+1} * VRATE_{1,p} \quad (D-43)$$

$$TEMPHC_{2,t+1} = HUTC_{2,t+1} * VRATE_{2,p} \quad (D-44)$$

$$TEMPHC_{3,t+1} = HUTC_{3,t+1} * VRATE_{3,p} \quad (D-45)$$

$$TEMPHC_{4,t+1} = HUTC_{4,t+1} * VRATE_{4,p} \quad (D-46)$$

$$TEMPHC_{5,t+1} = HUTC_{5,t+1} * VRATE_{5,p} \quad (D-47)$$

$$TEMPHC_{6,t+1} = HUTC_{6,t+1} * VRATE_{6,p} \quad (D-48)$$

In general, the new population increment for each age cohort would be the sum across each housing type, of the product of the number of newly available units, household size (HHSIZE), and the appropriate age distribution (AGE). In the following equations, the new population of the Fairfield planning area (NPOPF) for each cohort category in these equations is the newly occupied housing units in the Fairfield planning area (HUF) multiplied by the household size and the age distribution appropriate to that household size and then summed over all categories of housing units. The subscript "k" indicates the discrete increments of household categories from 1 to 6.

$$NPOPF_{5,t+1} = \sum_{k=1}^{6} \Delta HUF_{k,t+1} * HHSIZE_{k,t} * AGE_{k,5,p} \quad \text{(D-49)}$$

$$NPOPF_{4,t+1} = \sum_{k=1}^{6} \Delta HUF_{k,t+1} * HHSIZE_{k,t} * AGE_{k,4,p} \quad \text{(D-50)}$$

$$NPOPF_{3,t+1} = \sum_{k=1}^{6} \Delta HUF_{k,t+1} * HHSIZE_{k,t} * AGE_{k,3,p} \quad \text{(D-51)}$$

$$NPOPF_{2,t+1} = \sum_{k=1}^{6} \Delta HUF_{k,t+1} * HHSIZE_{k,t} * AGE_{k,2,p} \quad \text{(D-52)}$$

$$NPOPF_{1,t+1} = \sum_{k=1}^{6} \Delta HUF_{k,t+1} * HHSIZE_{k,t} * AGE_{k,1,p} \quad \text{(D-53)}$$

The new population in the Cordelia planning area (NPOPC) is calculated in the same way as the new population for the Fairfield planning area. Equations D-54 through D-58 compute the new population for each of the five cohort categories where HUC is the number of occupied housing units in the Cordelia area and HHSIZE and AGE are the parameters for the specific house-

hold size and age distributions specific to each housing category. Again, in these equations, housing categories are indicated by the subscript "k".

$$NPOPC_{5,t+1} = \sum_{k=1}^{6} \Delta HUC_{k,t+1} * HHSIZE_{k,t} * AGE_{k,5,p} \qquad (D-54)$$

$$NPOPC_{4,t+1} = \sum_{k=1}^{6} \Delta HUC_{k,t+1} * HHSIZE_{k,t} * AGE_{k,4,p} \qquad (D-55)$$

$$NPOPC_{3,t+1} = \sum_{k=1}^{6} \Delta HUC_{k,t+1} * HHSIZE_{k,t} * AGE_{k,3,p} \qquad (D-56)$$

$$NPOPC_{2,t+1} = \sum_{k=1}^{6} \Delta HUC_{k,t+1} * HHSIZE_{k,t} * AGE_{k,2,p} \qquad (D-57)$$

$$NPOPC_{1,t+1} = \sum_{k=1}^{6} \Delta HUC_{k,t+1} * HHSIZE_{k,t} * AGE_{k,1,p} \qquad (D-58)$$

The total new population of the City of Fairfield (NTOTFF) is computed in equation D-59 as the sum of the population in each cohort for the Fairfield and Cordelia planning areas (NPOPF and NPOPC, respectively):

$$NTOTFF_{t+1} = \sum_{k=1}^{5} NPOPF_{k,t+1} + NPOPC_{k,t+1} \qquad (D-59)$$

<u>Current School Population</u>

One of the major purposes of the demographic subsystem is to account for the population of the Fairfield-Suisun Unified School District and maintain these projections for use in the education subsystem. In the model students are disaggregated, like the population itself, into three categories: current students, new students from the Fairfield planning area, and new students from the Cordelia planning area.

Current students, or the existing students of the school system, come from the existing population of the Fairfield and Cordelia planning areas and some areas outside the City. As noted in Table D-1, the age groupings of this population were constructed so that cohorts 2, 3 and 4 approximate grade categories kindergarten through sixth grade, seventh and eighth, and ninth through twelfth grade respectively. This is outlined in Table D-3 below.

TABLE D-3

Cohort and Grade Categories

Cohort	Age Group	Grade Category	Grade
2	5-12	1	K-6
3	13-14	2	7-8
4	15-18	3	9-12

The existing population of the Fairfield-Suisun School District is determined from the existing survived and aged population of the Fairfield planning area (FPOP') and the Cordelia planning area (CPOP'). These population cohorts are multiplied by the grade-specific school participation rate parameters (PART) for each cohort to determine the existing students from the Fairfield (FSCHL) and Cordelia (CSCHL) planning areas. The participation rates are provided by the school district and assumed to be equal for both areas.

The Fairfield-Suisun Unified School District extends beyond the limits of the Fairfield and Cordelia planning areas. The district includes students from Suisun City and some unincorporated areas of Solano County. In the model these students are included as part of the students in the nearest planning area. Students from Suisun City (SSCHL) are added to the Fairfield planning area students (FSCHL). Students from other unincorporated areas are added to the Cordelia students (CSCHL). Because the major source of these extra students is from the Green Valley Estates they are identified by the mnemonic GVSCHL. These student populations from these areas are predicted by school officials to remain fairly stable in the near future. Thus, these values are assumed as constants in the model, but this assumption can be changed by user intervention.

Equations D-60 through D-62 compute the existing school population from the Fairfield planning area (FSCHL), with SSCHL representing the students for each grade level from Suisun City

$$FSCHL_{3,t+1} = (FPOP'_{4,t+1} * PART_{3,p}) + SSCHL_{3,p} \tag{D-60}$$

$$FSCHL_{2,t+1} \quad (FPOP'_{3,t+1} * PART_{2,p}) + SSCHL_{2,p} \tag{D-61}$$

$$FSCHL_{1,t+1} \quad (FPOP'_{2,t+1} * PART_{1,p}) + SSCHL_{1,p} \tag{D-62}$$

In a similar fashion equations D-63 through D-65 compute the existing students in the Cordelia planning area (CSCHL) where

GVSCHL represents the Green Valley students for each grade level.

$$CSCHL_{3,t+1} = (CPOP'_{4,t+1} * PART_{3,p}) + GVSCHL_{3,p} \quad \text{(D-63)}$$

$$CSCHL_{2,t+1} = (CPOP'_{3,t+1} * PART_{2,p}) + GVSCHL_{2,p} \quad \text{(D-64)}$$

$$CSCHL_{1,t+1} = (CPOP'_{2,t+1} * PART_{1,p}) + GVSCHL_{1,p} \quad \text{(D-65)}$$

Because the students in each grade category are computed from the current populations, after those populations have been age advanced, the students are automatically advanced through the grades each year.

New School Population

The next operation of the demographic subsystem is to calculate the additional school children that will result from immigration to the Fairfield and Cordelia planning districts. These calculations are maintained separately for each planning district and calculated independently for each grade category. In each case, the number of students in each grade category is assumed to be a function of the population in the appropriate cohort and the specific participation rate.

The number of new school children in the Fairfield planning district (NSCHLF) is calculated for each grade category in equations D-66 through D-68 where NPOPF is the cohort population of people who have moved into the Fairfield planning district in the current year. The grade specific participation

rate (PART) is assumed to be the same as that experienced for the current school population.

$$NSCHLF_{3,t+1} = NPOPF_{4,t+1} * PART_{3,p} \quad (D\text{-}66)$$

$$NSCHLF_{2,t+1} = NPOPF_{3,t+1} * PART_{2,p} \quad (D\text{-}67)$$

$$NSCHLF_{1,t+1} = NPOPF_{2,t+1} * PART_{1,p} \quad (D\text{-}68)$$

The same operation is performed for the Cordelia planning area in equations D-69 through D-71, where the total school population for each grade is identified by the subscripted mnemonic NSCHLC. Again, the participation rate for each grade category is assumed to remain constant and thus established as a parameter. This parametric rate is applied to the recent immigrants to the Cordelia planning area.

$$NSCHLC_{3,t+1} = NPOPC_{4,t+1} * PART_{3,p} \quad (D\text{-}69)$$

$$NSCHLC_{2,t+1} = NPOPC_{3,t+1} * PART_{2,p} \quad (D\text{-}70)$$

$$NSCHLC_{1,t+1} = NPOPC_{2,t+1} * PART_{1,p} \quad (D\text{-}71)$$

<u>Suisun City Population</u>

The CRIS demographic subsystem estimates the population of Suisun City (TOTS) as a function of the historic growth rate of that City's population. The growth rate of Suisun (GROWS) is assumed to remain constant over the projection period, though this assumption may have to be altered by user intervention.

$$TOTS_{t+1} = TOTS_{t} * GROWS_{p} \quad (D\text{-}72)$$

Solano County Population

The CRIS Model maintains an annual projection of the population of Solano County for use in the general revenue subsystem. Basically, the Solano County population projections are taken from ABAG's Series 3 estimates using the Base Case 1 assumptions. The Base Case 1 projection differs from the Base Case 2 projection in that it assumes a slightly higher rate of economic development and migration into the region.

The projection period in the CRIS Model is ten years. This can, for simplicity, be designated to include the period 1980 to 1989. Therefore, the ABAG Series 3 population projections of Solano County for 1980 (P_0) and 1990 (P_1) were used in the following equation to determine the natural logarithm of population growth (e^{rn}) where r is the continuous rate of growth and n is the interval over which the rate is computed.*

$$\frac{P_1}{P_0} = \frac{262,980}{206,548} = e^{rn} = 1.273$$

The value of rn is equal to .241. Because the value of n is known to be 10 years, the value of r or the continuous growth rate for Solano County population would be 2.414% (rn/n).

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* ABAG, Revised Series 3 Projections. (March 15, 1978) Pp. B-2 and B-14.

Then, the continuous growth rate is used in the model to determine the annual population of Solano County (TOTSC).

$$TOTSC_{t+1} = TOTSC_{t} * r \tag{D-74}$$

The total population of the County exclusive of the City of Fairfield (TOTSX) is computed in equation D-74 by subtracting the total current population of the City, total population in both planning areas, and the air base population from the total Solano County population determined above.

$$TOTSX_{t+1} = TOTSC_{t+1} - TOTFF_{t+1} - NTOTFF - TRAVIS_{p} \tag{D-75}$$

<u>Total Fairfield Population</u>

The total population for the City of Fairfield (TOTFN) is the sum of the current population of the City (TOTFF) and the new population (NTOTFF). The computation is made in equation D-76 below. This sum does not include Travis Air Force Base population.

$$TOTFN_{t+1} = TOTFF_{t+1} + NTOTFF_{t+1} \tag{D-76}$$

Since the air base is within the city limits the actual population of the City of Fairfield including both planning zones and Travis Air Force Base (TOTFNT) is computed in equation D-77. Again, the population of the Air Base (TRAVIS) is assumed to remain constant over the projection period. The user may, however, alter this assumption by merely changing the value of the parameter.

$$TOTFNT_{t+1} = TOTFN_{t+1} + TRAVIS_{p} \tag{D-77}$$

Chapter V

THE OPERATING SUBSYSTEMS

Introduction

The CRIS Model is designed to project the fiscal impacts from urban development. In the operation of the model the costs and revenues are estimated by separate operating subsystems. The CRIS model has nine subsystems.

Each operating subsystem is actually a series of equations which replicate the functions of the separate departments of the City of Fairfield or the single-purpose special districts which provide services and/or collect revenues from the residents of the City. The relationship of each CRIS operating subsystem to the relevant municipal department or special district is shown in Table V-1.

TABLE V-1

Subsystem	Department/Special District
General Revenues	City Clerk, City Treasurer, City Finance Department
Education	Fairfield-Suisun Unified School District
Police	City Police Department
Fire	City Fire Department
Sewer	Fairfield-Suisun Sewer District, City Public Works Department
Water	City Water Department
Streets and Roads	City Public Works Department
Parks and Recreation	City Parks and Recreation and Public Works Departments
General Government	City Manager, City Council, City Planning Department, City Personnel Department, City Clerk, City Treasurer, City Finance Department, City Purchasing Department, City Building Department

GENERAL REVENUE SUBSYSTEM

The general revenue subsystem of the CRIS Model encompasses four distinct categories of revenue for the Fairfield general funds:

(1) property tax revenues

(2) construction related revenues

(3) sales tax revenues

(4) other revenues

The general revenue subsystem does not include all revenue sources as it is primarily concerned with general fund revenues for the Fairfield city government. Other revenue portions of the CRIS Model include the separate Fairfield-Suisun Unified School District revenue functions which are a part of the education subsystem and the specialized revenue sources of the water, sewer, parks and recreation, and streets and roads subsystems.

As implied by their name, property tax, construction related, and sales tax revenues are classified on the basis of revenue sources. To the maximum extent possible, the CRIS Model estimates revenues on the basis of the formulae established by Fairfield City ordinances. For example, estimated revenues from property taxes for any year are computed by multiplying the established or anticipated tax rates by the total assessed valuation.

Category 4, the other revenue classification, includes revenues from a wide variety of sources and allocational formulae. These include Federal revenue sharing and other Federal grants, State cigarette taxes and State subventions (other than cigarette and sales tax), and recurring charges assessed by the City of Fairfield.

Property Tax Revenue

The revenue from property tax is based on the value of real property in the Fairfield and Cordelia planning areas. These property values are translated into assessed valuation by means of an assessed valuation function. The assessed values are calculated separately for each planning area. In addition, the assessed valuation equations estimate residential, commercial and industrial valuation separately. The separate values are then aggregated because only the total of all assessed value subject to local taxation is needed for the property tax function.

It is assumed, as is required by law, that the value of the undeveloped land is inlcuded in the total assessed valuation from the base year. Further, it is assumed that this land is already assessed at its "highest and best use," the policy of the Solano County Assessor. Thus, in the model, increases in assessed values are due soley to the values of the structures or other improvements placed on the land. This addition to property value is obtained directly from the structure values in the yearly development schedules.

In equation GR-2, FMVRC is the full market value of residential development while FMVCC and FMVIC represent the market value of commercial and industrial developments.

$$\Delta AVC_{t+1} = \left(\sum_{k=1}^{6} \Delta FMVRC_{k,t+1} + \Delta FMVCC_{t+1} + \Delta FMVIC_{t+1}\right) * AR_p \qquad \text{(GR-2)}$$

The total increase in assessed valuation from new development (ΔAV) is the sum of the increase in assessed valuation from the Fairfield and Cordelia planning areas.

$$\Delta AV_{t+1} = \Delta AVF_{t+1} + \Delta AVC_{t+1} \qquad \text{(GR-3)}$$

Basically, the total assessed valuation of the City of Fairfield is estimated by adding the assessed value of all property from the previous period (AV) to the increase in assessed valuation from developments during the current period (ΔAV). However, this total assessed value estimate must be adjusted for changes in development or market conditions which affect the property and assessed values. First, the assessed value is reduced to adjust for reductions in property value due to demolitions or transfer of the property from private to public (tax exempt) ownership. The demolition adjustment parameter (DA) accounts for the decreases in assessed value due to these changes. However, because no significant redevelopment projects requiring major demolitions are contemplated by City officials during the projection period, the value of the demolition parameter is initially set at zero.

Throughout the CRIS Model, values are expressed in constant 1978 dollars. The model considers inflation by assuming that the inflation rate affects all costs equally. Generally, this assumption will hold true. However, it must be recognized that this assumption can have serious implications in the property tax revenue function. If the increase in property values is more rapid than the general inflation rate, the model will tend to underestimate the property tax revenues.

The increase in assessed valuation from newly developed property in the Fairfield planning area (ΔAVF) is computed in equation GR-1. The increase in assessed value is calculated from the sum of the full market value of residential (FMVRF), commercial (FMVCF), and industrial (FMVIF) property constructed in the planning area. The full market value is then multiplied by the parametric assessment ratio (AR) to determine the actual assessed value. In the following equation, the market value of residential property must be summed over the six categories of residential dwelling units. These housing unit types are identified by the k subscript to the mnemonic.

$$\Delta AVF_{t+1} = \left(\sum_{k=1}^{6} \Delta FMVRF_{k,t+1} + \Delta FMVCF_{t+1} + \Delta FMVIF_{t+1}\right) * AR_p \qquad \text{(GR-1)}$$

The same method is followed to compute the increase in assessed valuation from development in the Cordelia planning area (ΔAVC).

The second adjustment to the total assessed valuation calculation compensates for the specific inflation in real property values. All revenues or expenditures in the CRIS Model are reported in constant dollar amounts. Therefore, no adjustment is required for general inflation. Historically, the inflation rate for real property has been higher than that for other goods and services. However, the Jarvis-Gann Amendment limits the increase in property tax assessments to 2% per year. This is far less than the actual increase in property values and less than the general inflation rate. This negative differential is mitigated somewhat because the initiative allows property to be reassessed following sale, construction or change in ownership. The real property inflation factor (RPIF) adjusts the total assessed valuation to compensate for any of these differences between the appreciation (or depreciation) of property values and the general inflation rate.

It is difficult to predict the difference between the inflation of real property values and the general inflation rate. For purposes of the present model, it is assumed that there will be no substantial difference between the two rates. Thus, the real property inflation factor is initially set at one. However, this assumption can be easily modified by user intervention.

$$AV_{t+1} = (AV_t - DA_{p,t+1} + \Delta AV_{t+1}) * RPIF_p \qquad \text{(GR-4)}$$

There are two functions relating to property tax revenues for the City of Fairfield. The first function projects property tax revenue not including debt service. Here, property tax rates are multiplied by the total assessed valuation (from GR-4) to produce the property tax revenues for general city operations. This is shown in equation GR-5 where PTR is the property tax revenues, TR is the current city tax rate, and PTDR is the property tax distribution ratio. The non-debt service tax rate is set by the user of the CRIS Model and assumed to be a parameter. Since passage of Proposition 13, this tax rate is set at 1%. In this case, the distribution ratio is the share of the county-collected property taxes on Fairfield property which is returned as revenue to the City.

$$PTR_{t+1} = AV_{t+1} * TR_p * PTDR_p \qquad \text{(GR-5)}$$

The second property tax function computes the revenues required for debt service on the outstanding municipal bonds. The purpose of this function is to generate only enough revenue to meet the annual bond payment.

The first operation is to calculate the tax rate required for debt service (TRDS). This tax rate is dependent on the aggregate value of the bonds outstanding prior to Proposition 13 and the total assessed valuation of property in the City.

The total value of the outstanding bonds is maintained in the CRIS Model. Initially, these values are obtained from the City and recorded in a matrix. Each year, the model makes adjustments to the outstanding debt matrix as bonds are retired.

The provisions of Proposition 13 allow adjustments in the property tax rate above the constitutional limit of 1% of the market value for bonds approved by the voters prior to passage of the initiative. All future bonds must be repaid from the revenues collected within the limitation on the property tax rate. Therefore, the annual payment for bonded indebtedness (PMTB) used in the calculation of the bond property tax rate is given by the matrix.

Equation GR-6 calculates the tax rate for debt service by dividing the annual bond payment (PMTB) by the total assessed valuation (AV) from GR-4.

$$TRDS_{t+1} = PMTB_{t+1} / AV_{t+1} \qquad \text{(GR-6)}$$

When applied to the assessed valuation (AV), the tax rate for debt service (TRDS) will produce just enough revenue to meet current bond obligations. The property tax revenues collected for existing debt obligations are not affected by the property tax distribution ratios. This property tax revenue for debt service (PTRDS) is computed in equation GR-7.

$$PTRDS_{t+1} = AV_{t+1} * TRDS_{t+1} \qquad \text{(GR-7)}$$

The total revenue from property taxes is the sum of the debt service and non-service and non-debt service property tax revenues. This calculation is made in equation GR-8.

$$RPT_{t+1} = PTR_{t+1} + PTRDS_{t+1} \qquad \text{(GR-8)}$$

Construction Related Revenue

The construction related revenue subsection examines the development schedules for the Cordelia and Fairfield planning areas. The specific characteristics of these developments (in terms of cost, size, number of dwelling units and other facility system requirements) are related to the schedule of construction fees and charges established by the city. This produces an estimate of construction related revenues for the general fund. All general fund construction-related revenues from residential development are included in this subsection, while some of the detailed charges and fees associated with commercial and industrial development are included in the sewer and water subsystems.

The construction-related revenue function produces two types of revenues: general fund and special fund revenues. Revenues from building, plumbing, heating and electric permits are deposited in the general fund. A special bedroom tax on new construction provides revenues for the development of park facilities and recreation activities. These revenues are counted separately as special fund revenues. A license tax on new construction is collected to provide special fund revenue

for the development of major streets, storm drains, bridges and fire stations. The funds provided by the construction license tax are deposited in the capital outlay fund.

For each structure requiring a building permit, the fee for that permit is the sum of a flat fee and an incremental fee. The actual amount of the incremental fee is based on the value of the structure in excess of $2,000. The incremental fee rate decreases with increases in structure value according to a five-step function.

In the CRIS Model, structural values for residential property are recorded as the total value of all residential construction for a specific development. The fees, however, are calculated on the actual structural value of each unit. Therefore, the value of each structure must be estimated by computing the average value of each residential structure. The following equation computes this average structural value for residential construction (ASVR) by dividing the number of residential structures constructed (ΔSTCR) into the total value of new residential construction (STVLR).

$$ASVR_{t+1} = STVLR_{t+1} / \Delta STCR_{t+1} \qquad \text{(GP-9)}$$

The following set of equations performs the same averaging calculation for commercial structures and industrial structures (ASVC and ASVI, respectively). In equation GP-10, STVLC is the

total valuation of commercial structures and ΔSTCC is the number of commercial structures constructed. Similarly, in equation GR-11, STVLI is the total value of industrial structures and the number of industrial structures is represented by the mnemonic ΔSTCI.

$$ASVC_{t+1} = STVLC_{t+1} \;/\; \Delta STCC_{t+1} \qquad \text{(GR-10)}$$

$$ASVI_{t+1} = STVLI_{t+1} \;/\; \Delta STCI_{t+1} \qquad \text{(GR-11)}$$

The incremental building permit fees are calculated on the basis of five increasing units of structural value. These increments are shown in the following table.

TABLE GR-1

Increments of Building Permit Structural Values

Increment	Structural Value
1	\$2,000 - \$25,000
2	\$25,001 - \$50,000
3	\$50,001 - \$100,000
4	\$100,001 - \$500,000
5	\$500,001 and above

Equation GR-12 calculates the incremental fee for residential building permits (BPIFR) by summing the product of the average residential structural value (ASVR) and the specific increment of the adjusted building permit incremental fee (ABPIF) as

denoted by the subscript. This value is then multiplied by the number of residential structures constructed ($\Delta STCR$) to obtain the total fee.

$$BPIFR_{t+1} = \sum_{i=1}^{5} ASVR_{t+1} * ABPIF_p * \Delta STCR_{t+1} \qquad \text{(GR-12)}$$

Equation GR-13 calculates the total incremental fee from commercial building permits (BPIFC) using the average structural value of commercial construction (ASVC) and the number of commercial structures ($\Delta STCC$).

$$BPIFC_{t+1} = \sum_{i=1}^{5} ASVC_{t+1} * ABPIF_p * \Delta STCC_{t+1} \qquad \text{(GR-13)}$$

The total incremental fee from industrial building permits (BPIFI) is calculated in equation GR-14 where ASVI is the average value of industrial structures and $\Delta STCI$ is the number of industrial structures constructed.

$$BPIFI_{t+1} = \sum_{i=1}^{5} ASVI_{t+1} * ABPIF_p * \Delta STCI_{t+1} \qquad \text{(GR-14)}$$

Equation GR-15 calculates the total number of new structures (ΔSTC) as the sum of the residential, commercial, and industrial structures constructed ($\Delta STCR$, $\Delta STCC$, and $\Delta STCI$, respectively).

$$\Delta STC_{t+1} = \Delta STCR_{t+1} + \Delta STCC_{t+1} + \Delta STCI_{t+1} \qquad \text{(GR-15)}$$

The total revenue from building permit flat fees (BPFFT) is simply computed by multiplying the flat fee for each structure (BPFF) by the total number of structures constructed (ΔSTC).

$$BPFFT_{t+1} = \Delta STC_{t+1} * BPFF_p \qquad \text{(GR-16)}$$

Equation GR-17 totals the revenues from the issuance of building permits (BPR). This is the sum of the flat fee on all building permits (BPFFT) plus the incremental fee for residential construction (BPIFR), commercial construction (BPIFC), and industrial construction (BPIFI).

$$BPR_{t+1} = (BPFFT_{t+1} + BPIFR_{t+1} + BPIFC_{t+1} + BPIFI_{t+1} \qquad \text{(GR-17)}$$

Other construction related revenues are obtained from the issuance of permits for plumbing, heating and cooling, and electrical installations. The other construction permit fees (CPF) are a total of the flat fees for plumbing permits (PPFF) heating and cooling permits (HCPFF) and electrical permits (EPFF) and incremental fees for each of these permit categories. In the following equation (GR-18), the flat fees for plumbing, heating and cooling, and electrical permits are multiplied by the number of structures constructed (ΔSTC) to produce the total flat fees for construction permits (CPFF).

$$CPFF_{t+1} = (PPFF_p + HCPFF_p + EPFF_p) * \Delta STC_{t+1} \qquad \text{(GR-18)}$$

The incremental fee for construction permits (CPIF) are based on the size of each structure. In the following equation, GR-19 the incremental fees for plumbing, heating and cooling, and electrical permits are identified as PPIC, HCPIC, and EPIC, respectively. These incremental fees are multiplied by the quotient of the total square-foot area (from the development schedule) of all structures built in any one year (ΔSTSZ), divided by 100.

$$CPIF_{t+1} = (PPIF_p + HCPIF_p + EPIF_p) * STSZ_{t+1} / 100 \qquad \text{(GR-19)}$$

Total construction permit fees (CPF) are the sum of the flat fees and incremental fees. This calculation is made in equation GR-20 below.

$$CPF_{t+1} = CPFF_{t+1} + CPIF_{t+1} \qquad \text{(GR-20)}$$

The last construction related revenue collected by the City of Fairfield is the construction license tax. This license tax provides revenues from the construction of residential and commercial structures for major capital improvements. These improvements include major streets, storm drains, bridges, and firehouse to serve the increasing population of the City and increases in commercial establishments within the City.

The CRIS Model divides housing units into six categories. The categories are determined by the type of housing unit, i.e., single family or multi-family and the number of bedrooms contained within the housing type. The six housing categories are outlined in Table GR-2 below.

TABLE GR-2

Housing Categories

Housing Category	Housing Type	Number of Bedrooms
1	Single Family	2
2	Single Family	3
3	Single Family	4+
4	Multi-Family	0-1
5	Multi-Family	2
6	Multi-Family	3+

In the model, the number of newly constructed housing units is taken directly from the development schedules for each planning area. The new housing units in the Fairfield planning area are represented by the mnemonic HUTF and HUTC represents the new units in the Cordelia planning area. Equations GR-21 through GR-26 calculate the total number of new housing units (ΔHUT) for each housing category. The category of housing unit is identified by the first mnemonic subscript.

$$\Delta HUT_{1,t+1} = \Delta HUTF_{1,t+1} + \Delta HUTC_{1,t+1} \qquad \text{(GR-21)}$$

$$\Delta HUT_{2,t+1} = \Delta HUTF_{2,t+1} + \Delta HUTC_{2,t+1} \qquad \text{(GR-22)}$$

$$\Delta HUT_{3,t+1} = \Delta HUTF_{3,t+1} + \Delta HUTC_{3,t+1} \qquad \text{(GR-23)}$$

$$\Delta HUT_{4,t+1} = \Delta HUTF_{4,t+1} + \Delta HUTC_{4,t+1} \qquad \text{(GR-24)}$$

$$\Delta HUT_{5,t+1} = \Delta HUTF_{5,t+1} + \Delta HUTC_{5,t+1} \qquad \text{(GR-25)}$$

$$\Delta HUT_{6,t+1} = \Delta HUTF_{6,t+1} + \Delta HUTC_{6,t+1} \qquad \text{(GR-26)}$$

The construction license revenue from single-family housing units (CLRSF) is computed in equation GR-27, from the sum of new housing units (ΔHUT) in categories 1 through 3 (single-family units). This sum is multiplied by the parametric license tax per single-family unit (CLTSF).

$$CLRSF_{t+1} = \left(\sum_{k=1}^{3} \Delta HUT_{k,t+1}\right) * CLTSF_{p} \qquad \text{(GR-2}$$

The construction license revenue from multi-family units (CLRMF) is computed in the same manner for housing categories 4 through 6 (multi-family units). In equation GR-28, CLTMF is the parametric construction license tax for multi-family units.

$$CLRMF_{t+1} = (\sum_{k=4}^{6} \Delta HUT_{k,t+1}) * CLTMF_p \qquad (GR-28)$$

The construction license revenues from commercial structures (CLRC) is a function of the floor area or size of the commercial building. The actual fee for each building is individually determined according to a rate structure which involves a decreasing cost per square foot as the total area increases. This fee schedule for commercial structures is shown in Table GP-3.

TABLE GP-3

Construction License Tax for Commercial Structures

Fee Per Square Foot	Square Footage Range
$0.30	For the first 15,000 square feet, plus
0.25	For the next 15,000 square feet, plus
0.20	For the next 70,000 square feet, plus
0.15	Over the first 100,000 square feet

In the CPIS Model, the fee is computed on the average commercial structure size ($\Delta ACSZ$). This average is calculated in equation GP-29 where ΔCSZ is the total floor area of commercial development and ΔCST is the number of commercial structures built in any year.

$$\Delta ACSZ_{t+1} = \Delta CSZ_{t+1} / \Delta CST_{t+1} \qquad (GP-29)$$

The construction license revenue from commercial development is then computed on the basis of this average of commercial struc-

ture size. Because of the decreasing fee per square foot, the average will tend to over estimate the total revenues, if the variation of commercial structure sizes is large. However, it is predicted that the model will not be sensitive to this small error.

Equation GR-30 computes the construction license revenues from commercial development (CLRC) where ACSZ is the average size of commercial structures from GR-36 and CLTC is the construction license tax for commercial development from the schedule outlined in Table GR-2.

$$CLRC_{t+1} = \Delta ACSZ_{t+1} * CLTC_p \qquad \text{(GR-30)}$$

Total construction related revenue (TCRR) is obtained by summing the building permit revenues (from GR-17) and the construction permit fees (from GR-20). The total of construction related revenues does not include the parks and recreation bedroom fee revenues nor the new construction license tax because these revenues go directly to special funds rather than the general fund.

$$TCRR_{t+1} = BPP_{t+1} + CPF_{t+1} \qquad \text{(GR-31)}$$

Sales Tax Revenue

Sales taxes are allocated to municipalities entirely on the basis of taxed sales by businesses located within the jurisdiction. However, the sales tax revenue subsection recognizes that the ultimate source of this revenue is the purchasing

power of the resident and visiting consumers. Thus, in the CRIS Model, the sales tax revenue equation looks to the source of sales tax revenue and starts with estimates of the purchasing power of both Fairfield residents and visiting consumers. More completely, sales tax revenues are estimated as a function of the personal income of the relevant market area, the ratio of local taxable purchases to income, and the tax rate.

The City of Fairfield is located along the main transportation corridor in Solano County, I-80, and serves as a major focus for the northern and central county area. The Fairfield merchants are a major provider of roadside services to travelers between the San Francisco Bay Area and Sacramento, the Sierra Nevada Mountains and the Reno-Tahoe area. Thus, the total market for Fairfield goods and services extends over much of central California. However, for computational convenience, it is assumed that Solano County residents represent the equivalent of this total market for Fairfield's taxable goods and services.

Taxable purchases of a population are estimated on the basis of personal income, population, and the proportion of personal income which has historically been spent on taxable items. A crucial and yet difficult to estimate factor in the sales tax revenue function is the proportion of taxable purchases of any residential group which will be made within the municipality. This proportion is referred to as the "capture rate."

It was not possible to measure directly the Fairfield merchants' capture rate of the taxable purchases by Fairfield residents. It proved even more difficult to estimate the capture rate of purchases of residents of the rest of the Fairfield market area (hereafter the portion of the Fairfield market area outside of the city limits is referred to be the proxy measure -- the rest of Solano County). Interviews with local business leaders and a review of several market studies for particular commercial projects also failed to produce reasonable estimates of the Fairfield capture rates for all taxable purchases.

To resolve this problem an equation was developed which computed all possible capture rates for consumers in the entire market -- both Fairfield and the rest of Solano County. This computation was made on the basis of the actual Fairfield sales tax proceeds, and estimated taxable purchases. The taxable purchases estimates were based on the number of households, household income and the ratio of taxable sales to income for the State of California. The computation yielded a set of relationships between capture rates. These relationships are shown in Table GR-4.

TABLE GR-4

Capture Rate for Taxable Purchases in Fairfield

Residents of	Capture Rate					
Fairfield	.50	.60	.65	.70	.75	.80
Rest of Solano County	.46	.37	.32	.28	.23	.19

Basically, the table indicates that if Fairfield residents make 50% of their estimated taxable purchases with Fairfield merchants, then the capture rate of estimated taxable purchases by residents from the rest of Solano County must be 46% to account for the total sales tax revenues received by the City.

Fairfield officials judged that a 70% capture rate for City residents was most reasonable. Thus, based on the relationship from the table, the capture rate for taxable purchases by residents from the rest of the County was 28%.

In the CRIS Model, total sales tax revenues are estimated from the sum of taxable purchases by Fairfield residents and the residents of Solano County. Taxable purchases are estimated on the basis of the disposable income of each consumer group. For Fairfield consumers, the total disposable income are estimated separately for current and immigrating residents, and then aggregated for the whole City. The disposable income of current Fairfield residents is estimated on a per capita basis. The purchasing power of the families who have moved to Fairfield is estimated on the basis of the fall market value of their housing unit. Residents of the rest of the market area, Solano County, are assumed to have disposable income which is a function of their average per capita income. However, in all cases, the calculations exclude the population of Travis Air Force Base since purchases at base facilities are not subject to State sales tax.

Equation GR-32 estimates the total disposable income of current Fairfield residents (DICP) as a function of per capita income or the amount of disposable income per person (DI/POP). Current Fairfield residents include the existing residents, their progeny, and the progeny of in-migrating residents. The total of these current residents is estimated by subtracting the cumulative total of all new (migrating) residents in the Fairfield and Cordelia planning area (NTOTFF) from the total city population (TOTFN).

$$DICP_{t+1} = (TOTFN_{t+1} - NTOTFF_{t+1})\ DI/POP_p \qquad \text{(GR-32)}$$

The disposable income of the people who migrate to Fairfield is assumed to be a function of the housing choice. Generally, families with greater disposable income will tend to select housing units with a higher full market value. Thus, the increase in disposable income from new residents (ΔDINP) is estimated as a function of the number of newly occupied housing units in the Fairfield planning area (HUF) and the Cordelia planning area (HUC) as the full market value of each unit (FMV/HU). These full market values for the newly occupied housing units are multiplied by the ratio of disposable income to market value (DI/MV) for each housing category and summed over all categories.

$$\Delta DINP_{t+1} = \sum_{k=1}^{6} ((\Delta HUF_{k,t+1} + \Delta HUC_{k,t+1}) * FMV/HU_{k,p} * DI/MV_{k,p}) \qquad \text{(GR-33)}$$

Equation GR-34 computes the total disposable income for all in-migrant residents (DINP) as the sum of the total disposable income from the previous period and the new increment of disposable income from new movers in the current period (ΔDINP).

$$DINP_{t+1} = DINP_t + \Delta DINP_{t+1} \qquad \text{(GR-34)}$$

The disposable income of the residents of the rest of the Fairfield market area, Solano County, is estimated as a function of the average per capita income. Equation GR-35 projects the disposable income of Solano County, exclusive of Fairfield and Travis, (DISC) where TOTSX is the population of the rest of the County area and DI/POP is the parametric ratio of disposable income to population. The value of this parameter, taken from the 1970 census of Solano County, is assumed to be the same for Fairfield as for the County exclusive of Fairfield.

$$DISC_{t+1} = TOTSX_{t+1} * DI/POP_p \qquad \text{(GR-35)}$$

Sales tax revenues are calculated for Fairfield residents and the residents of the rest of the market area separately. The first operation is to aggregate the total disposable incomes of the Fairfield consumers. Equation GR-36 computes the disposable income of Fairfield (DIF) by adding the disposable incomes of current residents (DICP) and residents who moved to the City during the projection period (DINP).

$$DIF_{t+1} = DICP_{t+1} + DINP_{t+1} \qquad \text{(GR-36)}$$

Equation GR-37 projects the estimated sales tax revenue from purchases by Fairfield consumers (STRF). Here TP/DI is the State average of taxable purchases to disposable income, CRF/TP is the capture rate for taxable purchases by Fairfield consumers, and MSTR is sales tax rate for municipal governments. The capture rate for Fairfield residents has previously been estimated at 70% of all taxable purchases. Currently, the local tax rate is 0.01.

$$STRF_{t+1} = DIF_{t+1} * TP/DI_p * CRF/TP_p * MSTR_p \qquad \text{(GR-37)}$$

Fairfield sales tax revenue from purchases by Solano County consumers (STRSC) is estimated in the same manner as that from Fairfield consumers by equation GR-38. Again TP/DI is the State average proportion of taxable purchases to disposable income and MSTR is the municipal sales tax rate. In this equation, the capture rate of taxable purchases by consumers from the rest of the County (CRS/TR) is assumed to be 28%.

$$STRSC_{t+1} = DISC_{t+1} * TP/DI_p * CRS/TP_p * MSTR_p \qquad \text{(GR-38)}$$

The treatment of sales tax receipts from new commercial establishments in Fairfield poses both computational and equity problems. The appropriate criteria for cost/revenue analysis in this case would be the "with" versus the "without" comparison, i.e., what will Fairfield sales tax receipts be with commercial development as contrasted to what they would be without new commercial development? Thus, in an extreme hypothetical case

where the local capture rate is 100% and the rest of the world's capture rate is 0%, the taxable sales of new commercial establishments would result in <u>no</u> net sales tax revenue gains for the community. This situation would result if the new commercial establishments sold only to local Fairfield residents who, in the absence of the establishment, would have shopped at existing Fairfield businesses.

If, however, a new commercial or industrial development in Fairfield does change the overall capture rate of Fairfield by creating a net gain in sales to Fairfield residents who otherwise would have shopped outside the City or spent less in Fairfield, then the changed capture rate can be estimated and directly inserted as input information for the model. At present, the capture rate is assumed to be constant.

The net gain in sales tax revenues from new commercial developments (NGSTRC) is assumed to be a function of sales tax revenue and the expected change in the capture rate for consumers in the market area. In the following equation (GR-39) ECCRCF the expected change in the capture rate of taxable purchases by Fairfield consumers and ECCRS is the expected change in the capture rate for Solano County consumers. The expected capture rate change due to new development is a judgment which must be made for each particular development. For purposes of the general projections, it has been assumed that the capture rate

will remain unchanged and, therefore, its initial value is set at zero. However, this assumption can be easily modified as particular commercial developments are considered.

$$NGSTRC_{t+1} = STRF_{t+1} * ECCRCF_p + STRSC_{t+1} * ECCRCS_p \qquad \text{(GR-39)}$$

Any type of development which brings people to or through the Fairfield area can have an effect on the sales tax capture rates. This is true even if no sales tax revenues are directly generated on the development site. For example, a large industrial park may bring non-Fairfield residents to the area to work. It is likely that while at or near the work site these workers will make taxable purchases. Thus, the capture rate for the County area (the proxy area) would be increased. Equation GR-40 is used to estimate the sales tax revenue associated with this non-commercial development. For purposes of the model industrial development is used to represent non-commercial development.

The net gain in sales tax revenues from industrial development (NGSTRI) is assumed to be a function of sales tax revenues and expected change in the capture rate for both Fairfield and Solano County. As with commercial development, changes in the capture rate are exogenous to the model. Therefore, it is assumed that the capture rates will remain constant (i.e., ECCRIF and ECCRIS = 0) unless an explicit case is made that the rates will change as a result of a particular development.

$$NGSTRI_{t+1} = STRF_{t+1} * ECCRF_p + STRSC_{t+1} * ECCRS_p \qquad \text{(GR-40)}$$

The total revenue from sales tax is computed in equation GR-41. In this equation TSTR is the total sales tax revenue.

$$TSTR_{t+1} = STRF_{t+1} + STRSC_{t+1} + NGSTRC_{t+1} + NGSTRI_{t+1} \qquad \text{(GR-41)}$$

Other Revenues

The "other" revenue subsection includes revenues from a variety of sources including Federal grants, State subventions, cigarette tax, dog licenses, parking tickets, and library fines. Some of the revenues in the other revenue classification, such as Federal revenue sharing, are allocated to the City on the basis of formulae which include population as a major determinant. However, most of these revenues are collected or allocated on the basis of a wide variety of conditions and circumstances. For computational simplicity, all revenues in this category are estimated in the CRIS Model on a per capita basis.

All of the per capita revenue functions have initially been calibrated using California State Controller revenue figures for fiscal years 1970-71 through 1973-74. These revenues are expressed in constant dollars and converted to per capita terms utilizing the ABAG Series 3 population projections. The per capita rates are initially assumed to be constant. However, because future conditions or legislative and Congressional actions affecting these revenues are difficult to predict, the user of the model can easily adjust the per capita parameters.

The other revenues are disaggregated into four categories: (1) recurring service charges, (2) Federal revenues, (3) State revenues, and (4) other City revenues.

Recurring service charge revenues are generated from several different sources. These include license and permit fees (i.e., dog and bicycle licenses), fines and penalties (i.e., parking and vehicle code fines), and service charges (i.e., special police and fire services, animal shelter fees, local assessments, lot cleaning, refuse collection, park and recreation user fees, and library fines). In equation GR-42, RSC represents the recurring service charge revenues. This is estimated as a function of recurring service charges per capita (RSC/POP) and the population of Fairfield including the planning areas of Fairfield and Cordelia and Travis Air Force Base. (TOTFNT).

$$RSC_{t+1} = TOTFNT_{t+1} * RSC/POP_p \qquad \text{(GR-42)}$$

Federal revenues (FR) include general revenue sharing as well as revenues from all Federal categorical block grant-in-aid programs. These revenues are estimated in equation GR-43 as a function of Federal revenues per capita (FR/POP) and total population including the air base.

$$FR_{t+1} = TOTFNT_{t+1} * FR/POP_p \qquad \text{(GR-43)}$$

Equation GR-44 estimates the general fund revenues from all State subventions other than sales taxes. In this equation, OSR represents the other State revenues and OSR/POP is the ratio of state revenues to population.

$$OSR_{t+1} = TOTFNT_{t+1} * OSR/POP_p \qquad (GR-44)$$

Equation GR-45 estimates the general fund revenues from all other sources, where OR represents these other revenues and OR/POP is the parameter for other revenues per capita.

$$OR_{t+1} = TOTFNT_{t+1} * OR/POP_p \qquad (GR-45)$$

Total per capita revenue (TPCR) is the sum of the revenues from the four per capita revenue functions. This is estimated in equation GR-46.

$$TPCR_{t+1} = RSC_{t+1} + FR_{t+1} + OSR_{t+1} + OR_{t+1} \qquad (GR-46)$$

Total General Revenues

In the CRIS Model, total general revenues (TR) are estimated as the sum of the revenues from the four revenue classifications.

$$TR_{t+1} = RPT_{t+1} + TCRR_{t+1} + TSTR_{t+1} + TPCR_{t+1} \qquad (GR-47)$$

EDUCATION SUBSYSTEM

The education subsystem of the CRIS Model projects both the costs and the revenues of the Fairfield-Suisun Unified School District. The subsystem computes general operating costs for both current and new students, transportation costs for school buses, and the capital cost of school facility construction and expansion. The revenues of the school district are organized by type and source. These revenues include state basic aid, other state revenues, federal revenues, other school revenues, property tax, property tax for bonded indebtedness, and state equalization aid.

The boundary of the Fairfield-Suisun Unified School District extends far beyond the incorporated city limits of Fairfield. The School District includes Suisun City and major unincorporated areas of Solano County. The District even extends beyond the limits of the Fairfield and Cordelia planning areas. However, for consistency in the model, the district is divided into two sections corresponding to the division of the Fairfield planning area and the Cordelia planning area. Students from Suisun City are considered to be part of the Fairfield planning area while students from the unincorporated areas are calculated as part of the Cordelia planning area.

The first operation of the education subsystem is to calculate

the operating cost for the school district. These costs include all of the costs associated with the students' education plus the cost of transporting the students to the school. The education subsystem considers current students and new students separately.

Education Costs

The cost of education for students includes the salaries for teachers, administrators, and other school personnel, school supplies, equipment, and the operating and maintenance cost of the school facility.

The education costs for current students in the Fairfield planning area (FECS) is calculated in equations E-1 through E-3 as a function of the number of students in each grade category for the Fairfield planning area (FSCHL) and the parametric cost per pupil (CPP) for the specific grade category. The number of existing students is taken directly from the demographic subsystem (equations D-64 through D-66) for this calculation. The mnemonics are subscripted as in the demographic subsystem to indicate the grade category.

$$FECS_{3,t+1} = FSCHL_{3,t+1} * CPP_{3,p} \quad \text{(E-1)}$$

$$FECS_{2,t+1} = FSCHL_{2,t+1} * CPP_{2,p} \quad \text{(E-2)}$$

$$FECS_{1,t+1} = FSCHL_{1,t+1} * CPP_{1,p} \quad \text{(E-3)}$$

The education costs for current students from the Cordelia

planning area (CECS) are calculated in the same fashion. The current Cordelia planning area students (CSCHL) are taken directly from the demographic subsystem (equations D-67 through D-69). The parametric cost per pupil (CPP) is specific to each grade category and is assumed to be the same as that used for the Fairfield planning area.

$$CECS_{3,t+1} = CSCHL_{3,t+1} * CPP_{3,p} \quad \text{(E-4)}$$

$$CECS_{2,t+1} = CSCHL_{2,t+1} * CPP_{2,p} \quad \text{(E-5)}$$

$$CECS_{1,t+1} = CSCHL_{1,t+1} * CPP_{1,p} \quad \text{(E-6)}$$

The total education costs for existing students in each planning area are simply calculated as the sum of the education costs for each grade category. This computation is performed in equation E-7 for the Fairfield planning area and E-8 for the Cordelia planning area.

$$FECS_{t+1} = FECS_{3,t+1} + FECS_{2,t+1} + FECS_{1,t+1} \quad \text{(E-7)}$$

$$CECS_{t+1} = CECS_{3,t+1} + CECS_{2,t+1} + CECS_{1,t+1} \quad \text{(E-8)}$$

Equation E-9 calculates the total education costs for existing students (ECS). This is computed as the sum of the education costs for current students in both planning areas.

$$ECS_{t+1} = FECS_{t+1} + CECS_{t+1} \quad \text{(E-9)}$$

The next operation of the education subsystem is to calculate the education costs for new students in the Fairfield planning

area (NECSF) and the Cordelia planning area (NECSC). These costs are calculated as a function of the number of new students and the cost per pupil parameter. In equations E-10 through E-12, the number of new students in the Fairfield planning area (NSCHLF) are taken from the demographic subsystem (equations D-70 through D-72). The new students from the Cordelia planning area (NSCHLC) are also taken from the demographic subsystem (equations D-73 through D-75). The cost per pupil (CPP) is assumed to be the same for new students as for existing students.

$$NECSF_{3,t+1} = NSCHLF_{3,t+1} * CPP_{3,p} \tag{E-10}$$

$$NECSF_{2,t+1} = NSCHLF_{2,t+1} * CPP_{2,p} \tag{E-11}$$

$$NECSF_{1,t+1} = NSCHLF_{1,t+1} * CPP_{1,p} \tag{E-12}$$

$$NECSC_{3,t+1} = NSCHLC_{3,t+1} * CPP_{3,p} \tag{E-13}$$

$$NECSC_{2,t+1} = NSCHLC_{2,t+1} * CPP_{2,p} \tag{E-14}$$

$$NECSC_{1,t+1} = NSCHLC_{1,t+1} * CPP_{1,p} \tag{E-15}$$

The total education costs for the School District are calculated by grade level within each planning district. Therefore, the total education costs for the Fairfield planning area (ECSF) are the sum of the costs for the existing students (FECS) and the costs for the new students (NECSF) in the Fairfield planning area. In the following equations (E-16 through E-18), the grade level is indicated by the first subscript.

$$ECSF_{3,t+1} = FECS_{3,t+1} + NECSF_{3,t+1} \tag{E-16}$$

$$ECSF_{2,t+1} = FECS_{2,t+1} + NECSF_{2,t+1} \tag{E-17}$$

$$ECSF_{1,t+1} = FECS_{1,t+1} + NECSF_{1,t+1} \tag{E-18}$$

The total education costs for schools within the Cordelia planning area (OCSC) are calculated in the same manner by summing the costs for current students (CECS) and the costs for new students (NECSC). Again, this calculation is made for each grade level independently, with the grade level being indicated by the first subscript to the mnemonic.

$$ECSC_{3,t+1} = CECS_{3,t+1} + NECSC_{3,t+1} \quad \text{(E-19)}$$

$$ECSC_{2,t+1} = CECS_{2,t+1} + NECSC_{2,t+1} \quad \text{(E-20)}$$

$$ECSC_{1,t+1} = CECS_{1,t+1} + NECSC_{1,t+1} \quad \text{(E-21)}$$

Equations E-22 and E-23 calculate the total education costs for the schools in the Fairfield and Cordelia planning areas respectively. In each case the calculation is made by summing the full operating costs over all school levels in each planning area.

$$ECSF_{t+1} = ECSF_{3,t+1} + ECSF_{2,t+1} + ECSF_{1,t+1} \quad \text{(E-22)}$$

$$ECSC_{t+1} = ECSC_{3,t+1} + ECSC_{2,t+1} + ECSC_{1,t+1} \quad \text{(E-23)}$$

The total education costs for the School District (SEC) are the sum of the costs for the schools in each planning area from equations E-22 and E-23. This calculation is made in equation E-24 below.

$$SEC_{t+1} = ECSF_{t+1} + ECSC_{t+1} \quad \text{(E-24)}$$

<u>Transportation Costs</u>

The transportation costs for the Fairfield-Suisun Unified School

District consists of the capital and operating costs for school buses. In the calculation of these costs several assumptions are made. First, it is assumed that the District owns sufficient buses to transport the current student population. Further, it is assumed that these buses are operating at full capacity. Therefore, the School District must purchase new buses to accommodate increases in the student population.

It is also assumed that the District does not sell any of its used buses. In the CRIS Model, buses are purchased in response to additions in the student population. Obviously, some of the older buses must be replaced. The model does not specifically account for this replacement. However, because the student population from current Fairfield residents is generally declining, it is assumed that the number of new buses purchased will allow for the gradual replacement of the older vehicles.

In the past, the School District has been bussing approximately 35% of the students. It is assumed that the District will continue to bus approximately 35% of the student population.

The number of new buses needed in any year (ΔBUS) is calculated for each planning area as a function of the total number of new students and the maximum daily capacity of the school buses (BUS/SCHL). This calculation is made in equation E-25 where

NSCHLF represents the new students in the Fairfield planning area (from equations D-65 through D-67) and NSCHLC represents the new students in Cordelia (from equations D-68 through D-70). The daily school bus capacity ratio (BUS/SCHL) has been established to be 200 students per bus, but this assumption can be easily modified. The coefficient accounts for the assumption that only 35% of the new students require transportation to school sites. The prime superscript indicates that the number of new buses needed is rounded down in each year so that there is no excess bus capacity left to the following year.

$$\Delta BUS'_{t+1} = .35(\sum_{j=1}^{3} NSCHLF_{j,t+1} + NSCHLC_{j,t+1}) * BUS/SCHL_p \quad \text{(E-25)}$$

Equation E-26 calculates the total inventory of buses for the School District.

$$BUS_{t+1} = BUS_t + \Delta BUS'_{t+1} \quad \text{(E-26)}$$

The capital costs for the purchase of new buses (BCC) is computed in equation E-27 where BUS is the number of new school buses needed and C/BUS is the parametic cost per bus.

$$BCC_{t+1} = \Delta BUS'_{t+1} * C/BUS_p \quad \text{(E-27)}$$

Equation E-28 computes the operating costs for the school buses (BOC). These operating costs include the costs associated with bus maintenance. The bus operating costs are calculated as a function of the total number of buses from equation E-26, the average number of school days in a year (SD) and the parametric operating cost per bus-day (OC/BD).

$$BOC_{t+1} = BUS_{t+1} * SD_p * OC/BD_p \tag{E-28}$$

The transportation costs for the District include both the capital and operating costs. Therefore, the total transportation costs (TRANS) are calculated in equation E-29 as the sum of the capital costs (BCC) from E-27 and the operating costs (BOC) from E-28.

$$TRANS_{t+1} = BCC_{t+1} + BOC_{t+1} \tag{E-29}$$

Enrollment and Capacity

The most significant operation in the education subsystem is the decision to increase classroom capacity in response to increased enrollment. The Fairfield-Suisun Unified School District school capacity is increased by the addition of portable classrooms at an existing school site or by the construction of a new permanent facility at a new site.

The education subsystem maintains the current status of classroom capacity. Increases in the classroom capacity are added to the initial capacity as given by School District officials. These capacities are maintained separately for each planning area and grade category.

When a new school is built, its core, or permanent capacity (PERM) is established. This permanent school has sufficient space and facilities to accommodate additional students through

the installation of portable classrooms. The portable classroom units constitute the portable capacity (PORT) of that school facility. However, the ability of any one permanent facility to accept portable classrooms is not unlimited. The maximum capacity of any school facility (CAPMAX) is the sum of the maximum capacity of the permanent school and the limit of the portable capacity.

The actual school capacity at any one time is the sum of the permanent capacity and the capacity of all portable units actually installed. This temporal capacity limit is known as the variable capacity (VCAP).

The school capacities are represented in figure E-1. Again, these capacities are aggregated across individual schools and maintained separately for each planning area by grade category.

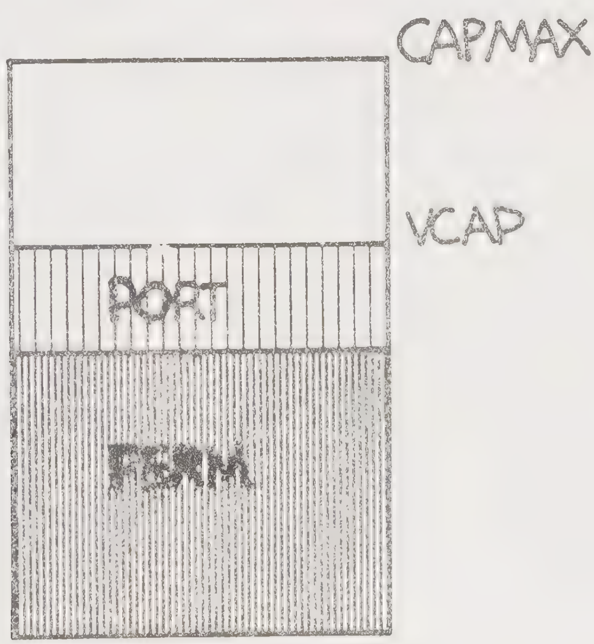

FIGURE E1 - SCHOOL CAPACITIES

Each year the demographic subsystem accounts for students entering and leaving the school system. If the number entering exceeds the number leaving, then total enrollment increases. In response, the education subsystem and the School District itself increase classroom capacities to meet the demands of an increasing enrollment.

The sequence by which school capacity increases is depicted in figure E-2. The initial school capacity is shown in Panel a. When the enrollment exceeds the existing VCAP, portable classrooms are added as shown in Panel b.

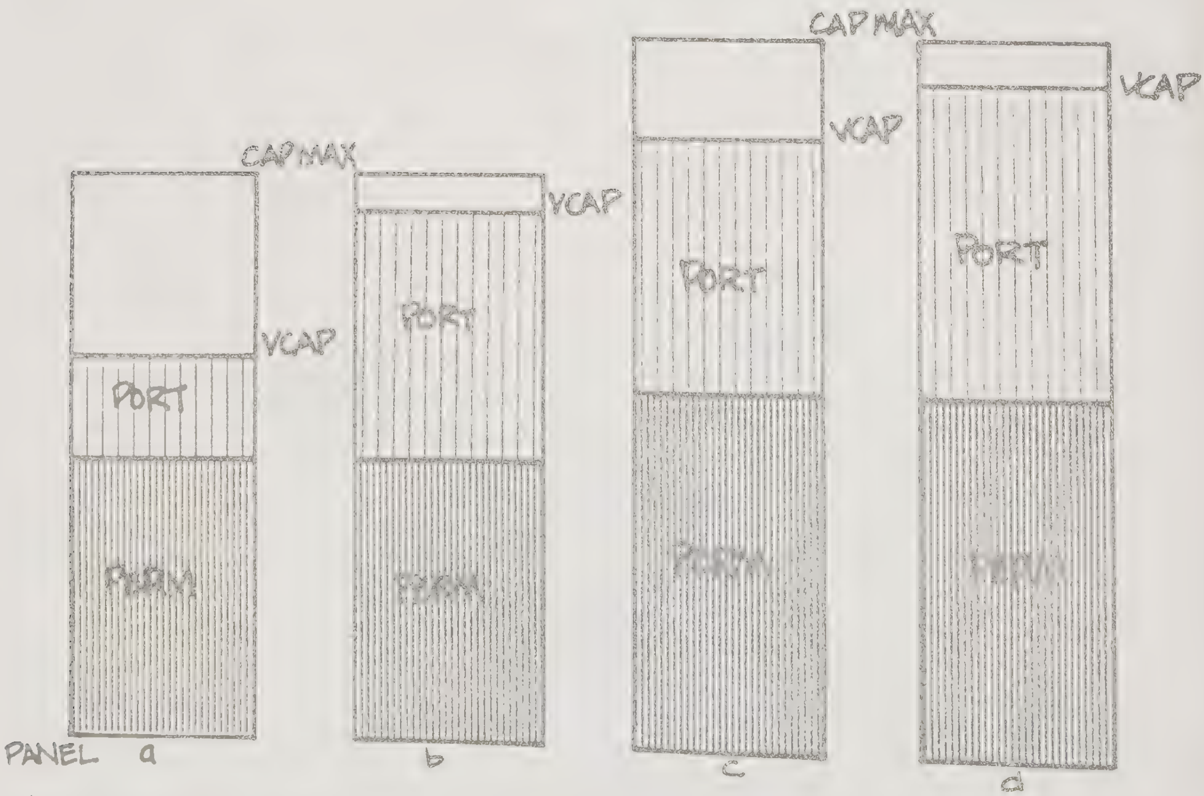

FIGURE E-2 · CAPACITY INCREASE SEQUENCE

As the portable capacity (PORT) is increased, the variable capacity (VCAP) will also be increased. When VCAP approaches the maximum capacity (Panel b), additional enrollment can no longer be accommodated by the installation of portable classrooms. Therefore, a new permanent school must be constructed (Panel c). This increases the permanent capacity (PERM), the variable capacity (VCAP), and the maximum capacity (CAPMAX). As enrollment increases further, the cycle begins anew with the installation of more portable units (Panel d).

The first operation in the enrollment and capacity process is to compute the total enrollment, by grade, for each planning area. The School enrollment from the Fairfield planning area (ENRF) is computed for each grade category in equations E-30 through E-32. Here, total enrollment is calculated as the sum of the existing students in each grade category (FSCHL) and the students who migrated into the planning area during the current year (NSCHLF). In the following equations, the mnemonics are subscripted to indicate grade category (See Table D-3).

$$ENRF_{3,t+1} = FSCHL_{3,t+1} + NSCHLF_{3,t+1} \qquad \text{(E-30)}$$

$$ENRF_{2,t+1} = FSCHL_{2,t+1} + NSCHLF_{2,t+1} \qquad \text{(E-31)}$$

$$ENRF_{1,t+1} = FSCHL_{1,t+1} + NSCHLF_{1,t+1} \qquad \text{(E-32)}$$

The total enrollment in the Cordelia planning area (ENRC) is calculated in the same manner as enrollment in the Fairfield

planning area. In equations E-33 to E-35, CSCHL represents the existing students in the Cordelia planning area and NSCHLC represents the new students.

$$ENRC_{3,t+1} = CSCHL_{3,t+1} + NSCHLC_{3,t+1} \quad \text{(E-33)}$$

$$ENRC_{2,t+1} = CSCHL_{2,t+1} + NSCHLC_{2,t+1} \quad \text{(E-34)}$$

$$ENRC_{1,t+1} = CSCHL_{1,t+1} + NSCHLC_{1,t+1} \quad \text{(E-35)}$$

Each year the newly computed enrollment figures are tested to determine if the school system has sufficient capacity to accommodate those students. Basically, there are three capacity tests in the education subsystem. The first test measures the enrollment for each grade category and planning area against the variable capacity of all schools in the relevant categories and areas. This test is performed in equations E-36 through E-38 for the Fairfield planning area and equations E-39 through E-41 for the Cordelia planning area. For descriptive purposes, the statistic that results from this calculation is given a specific mnemonic (EXCF and EXCC) for each planning area and grade category. However, the value of this mnemonic is limited to this description as no separate variable is created in the model.

$$EXCF_{3,t+1} = VCAPF_{3,t+1} - ENRF_{3,t+1} \quad \text{(E-36)}$$

$$EXCF_{2,t+1} = VCAPF_{2,t+1} - ENRF_{2,t+1} \quad \text{(E-37)}$$

$$EXCF_{1,t+1} = VCAPF_{1,t+1} - ENRF_{1,t+1} \quad \text{(E-38)}$$

$$EXCC_{3,t+1} = VCAPC_{3,t+1} - ENRC_{3,t+1} \quad \text{(E-39)}$$
$$EXCC_{2,t+1} = VCAPC_{2,t+1} - ENRC_{2,t+1} \quad \text{(E-40)}$$
$$EXCC_{1,t+1} = VCAPC_{1,t+1} - ENRC_{1,t+1} \quad \text{(E-41)}$$

If the result of each of these calculations are positive, then the School District has excess capacity and no additional classroom capacity is required for this year of operation. However, if, in any of the tests, the enrollment exceeds the current existing capacity, the value of the descriptive variable (EXCF or EXCC) will be negative. In that case, there is excess enrollment and the current students for that specific grade category and planning area cannot be accommodated by the current school capacity. These special cases are given the second test where the excess enrollment is measured against the potential capacity of the school system (CAPMAX) to determine if the students can be accommodated through the installation of portable classrooms. The basic operation of the test is shown in equations E-42 and E-43 below. The subscript "j" refers to the specific grade category.

$$EXCF_{j,t+1} \leq CAPMAXF_{j,t+1} - VCAPF_{j,t+1} \quad \text{(E-42)}$$
$$EXCC_{j,t+1} \leq CAPMAXC_{j,t+1} - VCAPC_{j,t+1} \quad \text{(E-43)}$$

If these conditions are met the excess enrollment is less than the allowable portable capacity; then portable classroom units are purchased and installed. The number of portable classrooms

required (ΔPORT) is calculated in equation E-44 and E-45 for each grade category and planning area. The grade category is indicated by the subscript "j". The double prime superscript indicates that the number of portable units required is rounded up to accommodate all excess enrollment without crowding.

$$\Delta PORTF''_{j,t+1} = EXCF_{j,t+1} * PORT/ENR_{p} \tag{E-44}$$

$$\Delta PORTC''_{j,t+1} = EXCC_{j,t+1} * PORT/ENR_{p} \tag{E-45}$$

If the condition in test 2 is violated, the total enrollment exceeds the maximum capacity of the school facilities in that grade category and area. These cases are tested to determine if there are sufficient excess students to necessitate the construction of a new permanent facility. In test 3, the excess enrollment in a specific grade category is tested against the standard of enrollment in a permanent facility for that category ($PERM_j$). This test is performed for each planning area in equation E-46 and E-49.

$$EXCF_{j,t+1} \geq PERM_{j,p} \tag{E-46}$$

$$EXCC_{j,t+1} \geq PERM_{j,p} \tag{E-47}$$

Historically, there has been a basic resistance on the part of School District officials to construct unnecessary permanent facilities. Therefore, if there is not sufficient extra enrollment to fill the new permanent facility, and the condition in test 3 is violated, the District has traditionally responded

by allowing a temporary condition of overcrowding to exist. In this case, portable classrooms are purchased and installed up to the maximum capacity limit and the extra students are temporarily accommodated within this capacity.

Here, the number of portable classrooms required for each planning area (ΔPORTF and ΔPORTC) are calculated for every grade category by multiplying the capacity of each portable unit by the difference between the existing capacity (VCAP) and the maximum capacity (MAXCAP). These calculations are performed in equations E-48 and E-49.

$$\Delta PORTF'_{j,t+1} = (CAPMAXF_{j,t+1} - VCAPF_{j,t+1}) * PORT/ENR_p \quad \text{(E-48)}$$

$$\Delta PORTC'_{j,t+1} = (CAPMAXC_{j,t+1} - VCAPC_{j,t+1}) * PORT/ENR_p \quad \text{(E-49)}$$

The cost of the portable classrooms required is computed in equation E-50. Here the sum of the units needed is multiplied by the parametric cost per unit (C/PORT).

$$CPORT_{t+1} = (\sum_{j=1}^{3} \Delta PORTF_{j,t+1} + \Delta PORTC_{j,t+1}) * C/PORT_p \quad \text{(E-50)}$$

However, if the condition in test 3 is met, then sufficient enrollment exists to warrant the construction of a new permanent school facility. The facility is constructed and costs of that construction are computed in equations E-51 through E-53 below.

Equation E-51 computes the capital costs for land (SCCL) required for construction of a new permanent school facility. This cost is computed by multiplying the minimum enrollment parameter for each school category ($PERM_j$) by the acreage requirement for each school category (AC/ENR_j) and the average cost of land per acre (ACL/AC). These factors are summed over all grade categories because new or additional capacity may be required in more than one category in a single year and, therefore, more than one school could be built.

$$SCCL_{t+1} = \sum_{j=1}^{3} (PERM_{j,p} * AC/ENR_{j,p}) * ACL/AC_{p} \qquad (E-51)$$

Equation E-52 computes capital costs for construction (SCCC) for all additional permanent schools in the district. This calculation is made by summing over all grade categories the product of the minimum enrollment parameter for a permanent facility ($PERM_j$) and the number of square feet of school space required for each student (SQ/ENR_j), and multiplying by the average construction cost per square foot (ACC/SQ_j).

$$SCCC_{t+1} = \sum_{j=1}^{3} PERM_{j,p} * SQ/ENR_{j,p} * ACC/SQ_{j,p} \qquad (E-52)$$

The total capital cost (SCCT) for the construction of new permanent school facilities is computed in equation E-53 as the sum of the capital costs for land (SCCL) and the capital costs for construction (SCCC).

$$SCCT_{t+1} = SCCL_{t+1} + SCCC_{t+1} \qquad (E-53)$$

The School District finances the cost of constructing permanent school facilities by issuing general obligations bonds. The actual capital costs of the School District are based on a payment schedule for all outstanding bonds. In general, the annual capital payment is calculated by revising the bond schedule to include the bonds issued for new construction in any year.

However, the Jarvis-Gann Initiative distinguishes between bonds passed by the voters prior to the adoption of the constitutional amendment and the bonds issued after the amendment. Proposition 13 limits the total property tax revenue to one percent of the market value of the land and improvements. An exception to this limitation is provided for the payment of bonds previously approved by the voters of the jurisdiction. Therefore, existing bonds and their associated payments are considered separately using data which is basic to the model. The payments on new general obligation bonds is calculated below.

School District bonds mature in twenty years. It is assumed that equal payments are made on the bonds each year. Equation E-54 calculates the annual payment for post-Jarvis bonds (ΔPMTJ) as a function of the total cost of new construction in that year (SCCT) and the current interest rate for education bonds (BIE).

$$\Delta PMTJ_{t+1} = (SCCT * BIE_p)/(1 - (1 + BIE_p) ** (-20)) \qquad (E-54)$$

The total post-Jarvis bond payment in any year is the total payment for bonded indebtedness incurred after the passage of Proposition 13. This total bond payment (PMTJ) is equal to the sum of the payments on bonds for the current year and the previous nineteen years. The calculation is made in equation E-55.

$$PMTJ_{t+1} = \sum_{r=o}^{19} \Delta PMTJ_{t+1-r} \qquad (E-55)$$

The education subsystem provides for the possibility that the excess enrollment in any grade category and planning area would require the construction of more than one permanent school facility in a single year. Once the model has determined (from test 3) that sufficient excess enrollment exists to warrant construction of a new permanent facility, tests 2 and 3 are repeated. The second testing process is based on new projections of the variable and maximum capacity for the specific grade categories and planning areas in question.

If the condition in test 2 is not violated, and the remaining students (those not required as part of the minimum enrollment of the permanent facility) are not in excess of the projected maximum capacity for that particular grade category and planning area, in this case the remaining students are accommodated through the installation of portable classrooms. The cost of this option is calculated as in equation E-50.

If the condition in test 2 is violated, then the maximum capacity standard required for construction of a new permanent facility (test 3) is applied. As before, if the remaining students exceed the projected maximum capacity, including the permanent facility, but do not meet the minimum capacity level of a new permanent school, the District will simply install extra portable units up to the projected capacity maximum. This will result in a temporary overcrowding condition for that grade category and planning area. Again, the cost of this option is computed as previously described in equation E-50.

Finally, if the condition in test 3 is met there is sufficient enrollment to necessitate the construction of a second permanent school facility. In that case, a second school will be constructed and the costs computed as in equation E-53. At that point, the CRIS Model will repeat tests 2 and 3 to make additional provisions for the allocation of the remaining enrollment.

Following these operations, the model revises the capacities of the School District by planning area and grade category. Equations E-55 through E-61 update the maximum capacities for each grade category and planning area. In each case, the capacity maximum (CAPMAX) from the previous period is increased

by the number of permanent facilities constructed in the present period ($\Delta PERM$) multiplied by the maximum capacity ($CM/PERM$) for each type of school facility.

$$CAPMAXF_{3,t+1} = CAPMAXF_{3,t} + \Delta PERMF_{3,t+1} * CM/PERM_{3,p} \quad (E-56)$$

$$CAPMAXF_{2,t+1} = CAPMAXF_{2,t} + \Delta PERMF_{2,t+1} * CM/PERM_{2,p} \quad (E-57)$$

$$CAPMAXF_{1,t+1} = CAPMAXF_{1,t} + \Delta PERMF_{1,t+1} * CM/PERM_{1,p} \quad (E-58)$$

$$CAPMAXC_{3,t+1} = CAPMAXC_{3,t} + \Delta PERMC_{3,t+1} * CM/PERM_{3,p} \quad (E-59)$$

$$CAPMAXC_{2,t+1} = CAPMAXC_{2,t} + \Delta PERMC_{2,t+1} * CM/PERM_{2,p} \quad (E-60)$$

$$CAPMAXC_{1,t+1} = CAPMAXC_{1,t} + \Delta PERMC_{1,t+1} * CM/PERM_{1,p} \quad (E-61)$$

The permanent capacities (PERM) are revised for each grade category and planning area as a result of the construction of new permanent facilities ($\Delta PERM$). This revision is performed in equations E-62 to E-67 by adding the new increment of permanent facilities in each category and planning area, times the minimum enrollment parameter ($PERM_j$), to the existing permanent capacity in those areas.

$$PERMF_{3,t+1} = PERMF_{3,t} + \Delta PERMF_{3,t+1} * PERM_{3,p} \quad (E-62)$$

$$PERMF_{2,t+1} = PERMF_{2,t} + \Delta PERMF_{2,t+1} * PERM_{2,p} \quad (E-63)$$

$$PERMF_{1,t+1} = PERMF_{1,t} + \Delta PERMF_{1,t+1} * PERM_{1,p} \quad (E-64)$$

$$PERMC_{3,t+1} = PERMC_{3,t} + \Delta PERMC_{3,t+1} * PERM_{3,p} \quad (E-65)$$
$$PERMC_{2,t+1} = PERMC_{2,t} + \Delta PERMC_{2,t+1} * PERM_{2,p} \quad (E-66)$$
$$PERMC_{1,t+1} = PERMC_{1,t} + \Delta PERMC_{1,t+1} * PERM_{1,p} \quad (E-67)$$

Similarly, portable capacity (PORT) is updated as a result of the purchase and installation of new portable classrooms (ΔPORT). Equations E-68 through E-73 revise the portable capacities for each grade category and planning area where PORTF represents the portable capacities in the Fairfield planning district and PORTC represents the portable capacities in the Cordelia planning district. The new portable capacity is determined by multiplying the portable classroom capacity parameter ($PORT_p$) by the number of new portable units and adding this increment to the new capacity.

$$PORTF_{3,t+1} = PORTF_{3,t} + \Delta PORTF_{3,t+1} * PORT_{3,p} \quad (E-68)$$
$$PORTF_{2,t+1} = PORTF_{2,t} + \Delta PORTF_{2,t+1} * PORT_{2,p} \quad (E-69)$$
$$PORTF_{1,t+1} = PORTF_{1,t} + \Delta PORTF_{1,t+1} * PORT_{1,p} \quad (E-70)$$

$$PORTC_{3,t+1} = PORTC_{3,t} + \Delta PORTC_{3,t+1} * PORT_{3,p} \quad (E-71)$$
$$PORTC_{2,t+1} = PORTC_{2,t} + \Delta PORTC_{2,t+1} * PORT_{2,p} \quad (E-72)$$
$$PORTC_{1,t+1} = PORTC_{1,t} + \Delta PORTC_{1,t+1} * PORT_{1,p} \quad (E-73)$$

Finally, the education subsystem updates the variable capacity (VCAP). Variable capacity is computed as the sum of the exis-

ting permanent capacity and the installed portable capacities for each grade category and planning area. Thus, increases in the variable capacity are calculated by adding the increased permanent capacity (ΔPERM) and the increased portable capacity (ΔPORT) to the existing variable capacity from the previous period. These calculations are performed in equations E-74 through E-79 where VCAPF is the variable capacity for each grade category in the Fairfield planning area and VCAPC is the variable capacity for the Cordelia planning area.

$$VCAPF_{3,t+1} = VCAPF_{3,t} + \Delta PERMF_{3,t+1} + \Delta PORTF_{3,t+1} \quad \text{(E-74)}$$

$$VCAPF_{2,t+1} = VCAPF_{2,t} + \Delta PERMF_{2,t+1} + \Delta PORTF_{2,t+1} \quad \text{(E-75)}$$

$$VCAPF_{1,t+1} = VCAPF_{1,t} + \Delta PERMF_{1,t+1} + \Delta PORTF_{1,t+1} \quad \text{(E-76)}$$

$$VCAPC_{3,t+1} = VCAPC_{3,t} + \Delta PERMC_{3,t+1} + \Delta PORTC_{3,t+1} \quad \text{(E-77)}$$

$$VCAPC_{2,t+1} = VCAPC_{2,t} + \Delta PERMC_{2,t+1} + \Delta PORTC_{2,t+1} \quad \text{(E-78)}$$

$$VCAPC_{1,t+1} = VCAPC_{1,t} + \Delta PERMC_{1,t+1} + \Delta PORTC_{1,t+1} \quad \text{(E-79)}$$

Operating Costs

The Fairfield-Suisun Unified School District pays for portable classrooms out of current revenues, rather than issuing bonds. Thus, the cost of portable units (CPORT) is considered to be part of the operating costs. Other operating costs for the District are the education costs for students (SEC), the transportation costs (TRANS) and the payments for post-Jarvis school bonds (PMTJ). Equation E-80 calculates the total operating costs for the District (SOC) as the sum of these.

$$SOC_{t+1} = SEC_{t+1} + TRANS_{t+1} + CPORT_{t+1} + PMTJ_{t+1} \qquad (E-80)$$

Equation E-81 computes the total cost of the School District (STC) as a sum of the operating costs (SOC) and the capital costs for the annual payment of bonded indebtedness incurred prior to Proposition 13 (PMT). This bond payment is taken directly from schedules in the base data for the model.

$$STC_{t+1} = SOC_{t+1} + PMT_{t+1} \qquad (E-81)$$

Education Revenue

Generally, in the CRIS Model, all revenues are estimated as part of the General Revenue Subsystem. However, Fairfield-Suisun Unified School District is jurisdictionally separate from the City of Fairfield and the District has independent taxing authority. Thus, the revenues of the School District are projected as part of the Education Subsystem.

School District revenues are organized by source and type. The sources of education revenues include the federal government, the State of California, Solano County and the District itself. Within the source category, revenues are aggregated by type, where appropriate.

Frequently, the allocation of assistance to the District is based on the average daily attendance of students in the schools. The CRIS Model also calculates the allocation of

education revenues on the basis of average daily attendance (ADA). ADA is computed separately for students in each grade category and then aggregated as necessary in the revenue estimation calculation.

The ADA for any specific grade category is based on the total enrollment in that category. The total high school (grades 9-12) enrollment (ENR_3) is calculated as the sum of the enrollment in a specific grade category from each planning area.

$$ENR_{3,t+1} = ENRF_{3,t+1} + ENRC_{3,t+1} \quad \text{(E-82)}$$

The same operation is performed for intermediate school (grades 7 and 8) enrollment (ENR_2) and elementary school (grades K-6) enrollment (ENR_1) in equations E-83 and E-84 respectively.

$$ENR_{2,t+1} = ENRF_{2,t+1} + ENRC_{2,t+1} \quad \text{(E-83)}$$

$$ENR_{1,t+1} = ENRF_{1,t+1} + ENRC_{1,t+1} \quad \text{(E-84)}$$

The estimated average daily attendance (ADA) is computed for each grade category in equations E-85 through E-87. In each case, this calculation is made by multiplying the total enrollment for a grade category by the category specific attendance rate parameter (ATTN).

$$ADA_{3,t+1} = ENR_{3,t+1} * ATTN_{3,p} \quad \text{(E-85)}$$

$$ADA_{2,t+1} = ENR_{2,t+1} * ATTN_{2,p} \quad \text{(E-86)}$$

$$ADA_{1,t+1} = ENR_{1,t+1} * ATTN_{1,p} \quad \text{(E-87)}$$

Federal assistance to the Fairfield-Suisun Unified School District includes aid under the National Defense Education Act, the Vocational Education Act, the Elementary and Secondary Education Act and some other minor authorities. Federal revenues to the District (SDFR) are estimated in equation E-88 on the basis of the total average daily attendance. In the following equation FR/ADA is the parametric rate of Federal assistance per average daily attendance.

$$SDFR_{t+1} = \sum_{j=1}^{3} ADA_{j,t+1} * FR/ADA_{p} \quad \text{(E-88)}$$

In the Education Subsystem, State aid to the School District is separated into three basic types: (1) basic aid, (2) equalization aid, and (3) other State revenues. Other State revenues include special education assistance for physically handicapped, deaf, blind, educatable mentally retarded, severely mentally retarded, educationally handicapped and mentally gifted students. The other State revenue category also includes: governmental support, allowances for inflation, allowances for certified retirement, allowances for adult students, apportionment for small schools, apportionment for special purpose training, special allowances, and tax relief subventions. The total of all revenue in the other state revenues category (SDOSR) is estimated on the basis of total ADA in equation E-88. In this computation, OSR/ADA is the combined parameter for the rate of State revenues per unit of average daily attendance.

$$SDPSR_{t+1} = \sum_{j=1}^{3} ADA_{j,t+1} * OSR/ADA_{p} \quad \text{(E-89)}$$

Education revenues from the School District itself come in the form of taxes on the real property of the District. These property tax revenues are disaggregated into two categories, the non-bond property taxes including post-Jarvis bonds and property taxes for prior bonded indebtedness.

The property tax revenues, from either category, are computed on the basis of the total assessed valuation of property in the School District (SDAV). The District's total assessed valuation is increased each year as a result of new development in the Fairfield and Cordelia planning areas. The total assessed valuation from new projects (ΔAV) is taken from equation GR-3. The total assessed valuation of the District is estimated in equation E-90, by adding the increment of assessed valuation from new construction to the assessment value from the previous period.

$$SDAV_{t+1} = SDAV_t + \Delta AV_{t+1} \qquad (E-90)$$

Non-bond property taxes (PTNB) are computed in equation E-91 by multiplying the non-bond property tax rate (PTRNB) times the total assessed valuation for the School District (SDAV). Since, according to the Jarvis-Gann Initiative, property taxes are collected by Solano County and distributed to districts within the county, it is necessary to factor the property

taxes collected by the ratio which is actually returned to the School District. In the following equation, this school property tax distribution ratio is identified by the mnemonic PTDRS.

$$PTNB_{t+1} = SDAV * PTRNB_p * PTDRS_p \qquad (E-91)$$

Property taxes for bonded indebtedness incurred prior to Proposition 13 are assessed to cover the cost of pre-Jarvis bond payments. The total taxes raised in any year are simply those required to cover the total payment on the principal and interest on the outstanding school bond (PMT). Therefore, the property tax rate for bonded indebtedness (PTRB) is computed as a function of the total assessed valuation of the District (SDAV) and the pre-Jarvis bond payment. This computation is made in equation E-92 below.

$$PTRB_{t+1} = PMT_{t+1} / SDAV_{t+1} \qquad (E-92)$$

The total property taxes for bonded indebtedness (PTB) are calculated in equation E-93 by multiplying the property tax rate for bonded indebtedness by the assessed valuation of the School District.

$$PTB_{t+1} = PTRB * SDAV_{t+1} \qquad (E-93)$$

Total property tax revenues for the School District (SDPTR) is computed as the sum of the non-bond property taxes and the property taxes for payments on school bonds.

$$SDPTR_{t+1} = PTNB_{t+1} + PTB_{t+1} \tag{E-94}$$

The majority of State assistance to the Fairfield-Suisun Unified School District comes from the State School Fund in the form of basic and equalization aid. Apportionments to the School District from the State School Fund are based on the "Foundation Program". The formulas in the Foundation Program attempt to equalize the income received by school districts on the basis of their ability to raise local tax revenues. The Foundation Program is, therefore, a computational factor that represents a minimum acceptable expenditure for each students education. The actual amount used as the foundation minimum for each grade category is based on rates set by the State Legislature.

All school districts, regardless of local wealth, are guaranteed basic aid. The basic aid rate is $125 per unit of average daily attendance. Revenues from equalization aid are determined by the difference between the Foundation Program's minimum and the sum of the school district's basic aid and "district aid" (determined by application of a standard tax rate to the district's assessed valuation). Thus, the larger a district's assessed valuation, the greater will be its computed "district aid" and the less will be the actual equalization aid paid out of the State School Fund.

The revenues from basic aid for the School District are computed on the basis of average daily attendance (ADA) and parametric rate of basic aid per unit of average daily attendance. The computation is made separately for grade school students (grades K-8) and high school students (grades 9-12). The basic aid for grade school students (BAG) is computed in equation E-95 by summing the units of average daily attendance across grades K through 8 (equations E-83 and E-84) and multiplying by the basic aid parameter specific to those grades (BAG/ADA).

$$BAG_{t+1} = \sum_{j=1}^{2} ADA_{j,t+1} * BAG/ADA_{p} \qquad (E-95)$$

Similarly, the basic aid for high school students (BAH) is calculated by multiplying the average daily attendance for that grade category (E-82) by the category-specific basic aid parameter (BAH/ADA).

$$BAH_{t+1} = ADA_{3,t+1} * BAH/ADA_{p} \qquad (E-96)$$

The total basic aid for the District (BA) is calculated in equation E-97 as the sum of the basic aid from grade school and high school students.

$$BA_{t+1} = BAG_{t+1} + BAH_{t+1} \qquad (E-97)$$

Equalization aid for the District is determined, as described above, for grade school students and high school students separately. In each case, the Foundation Program minimum

for a student's education is multiplied by the average daily attendance to determine the total foundation program for the district. From this district foundation program is subtracted the total basic aid from equation E-97 and the "district aid." "District aid" is calculated by multiplying the parametric district aid rate (DAR), or minimum tax rate, by the total assessed valuation of the school district (SDAV).

Computation of the equalization aid for grade school students (EAG) is made in equation E-98. In this equation, FPG/ADA is the parametric Foundation Program minimum for the education of each grade school student.

$$EAG_{t+1} = (\sum_{j=1}^{2} ADA_{j,t+1} * FPG/ADA) - BAG_{t+1} - (SDAV_{t+1} * DAR_p) \qquad \text{(E-98)}$$

Similarly, the computation of equalization aid for high school students (EAH) is made in equation E-99, using the parametric Foundation Program minimum for high school students education (FPH/ADA). Again, the calculation subtracts the estimates of basic aid and "district aid".

$$EAG_{t+1} = (ADA_{3,t+1} * FPH/ADA) - BAH_{t+1} - (SDAV_{t+1} * DAR_p) \qquad \text{(E-}$$

Total equalization aid (EA) for the School District is the sum of the aid for grade and high school students.

$$EA_{t+1} = EAG_{t+1} + EAH_{t+1} \qquad \text{(E-100)}$$

The School District receives education revenues (equalization aid offsets, taxes, or miscellaneous funds) from Solano County and from combined State and Federal incomes. In the model these other education revenues (OER) are estimated on the basis of average daily attendance. This calculation is made in equation E-101, where OER/ADA is the combined parametric estimator of other revenues per unit of average daily attendance.

$$OER_{t+1} = \sum_{j=1}^{3} ADA_{j,t+1} * OER/ADA_{p} \qquad \text{(E-101)}$$

The total revenues for the Fairfield-Suisun Unified School District (SDTR) are calculated as the sum of the education revenues from all sources. This computation is made in equation E-102 below.

$$SDTR_{t+1} = SDFR_{t+1} + SDOSR_{t+1} + SDPTR_{t+1} + BA_{t+1} + EA_{t+1} + OER_{t+1} \qquad \text{(E-102)}$$

One additional revenue for the School District is not summed as part of the total revenue because of its restricted use. This is the school impact fee. The fee is collected from developers of residential dwelling units and may be used only for the purchase of portable classrooms at schools which are temporarily crowded because of the new construction.

The actual amount of the school impact fee is based on the number of bedrooms in the dwellings. The current fee structure is shown in Table E-1.

TABLE E-1

School Impact Fee

Housing Category	Housing Type	Number of Bedrooms	School Impact Fee
1	Single Family	2	$300
2	Single Family	3	$500
3	Single Family	4+	$600-800
4	Multi-Family	0-1	-0-
5	Multi-Family	2	$300
6	Multi-Family	3+	$500-600

Equation E-103 computes the school impact fee revenue (SIFR) for each type of dwelling unit as denoted by the subscript. In the following equation, ΔHUT is the number of newly constructed dwelling units and SIF is the bedroom-specific, parametric school impact fee.

$$SIFR_{w,t+1} = \Delta HUT_{w,t+1} * SIF_{w,p} \qquad (E\text{-}103)$$

The total revenue from school impact fees (SIFT) is computed in equation E-104 by summing the fees paid on each type of dwelling unit.

$$SIFT_{t+1} = \sum_{w=1}^{6} SIFR_{w,t+1} \qquad (E\text{-}104)$$

POLICE SUBSYSTEM

The expenses for the police department constitute the largest share of Fairfield's annual budget. The Police Subsystem of the CRIS Model is designed to estimate future Police Department requirements and budgets as the city develops in both the Fairfield and Cordelia planning areas.

The CRIS Police Subsystem computed the total cost for the Police Department as a sum of capital and operating costs. The capital costs of the Police Department includes construction of new facilities to serve the increasing population and the purchase of patrol and investigator vehicles. Operating costs include expenses for salaries, vehicle maintenance, vehicle operation and other general expenditures.

Police Salary Costs

Police service is a 24-hour function. As a consequence, the City must hire approximately thirteen personnel for every two 24-hour shifts that are required. Two 24-hour slots require 336 hours per week of patrol time, or the equivalent of about 9 new sworn officers. In addition, for every eight to ten sworn officers added, the department requires the services of one sergeant; an investigator; one or two non-sworn personnel for clerical, dispatch, and support work; and a community service aide for crime prevention and other activities.

Police officers require substantial training and must be relatively well paid. The department considers their time to be unprofitably spent if they are performing duties which do not require sworn officers. For this reason, the department tries to use as many non-sworn personnel and volutary workers (reserves and cadets) as is feasible for routine operations.

Generally, the Police Subsystem estimates the annual expenditures for the Police Department as a function of the total population served. Specifically, the Fairfield Police Department has historically estimated the number of sworn officers needed as a function of the total population. This standard ratio of sworn officers to population (in thousands) is taken from Fairfield Police Department reports. It has been assumed to remain constant over the projection period; however, it has not been verified empirically and may be modified as necessary. The CFIS Model uses the same function to determine manpower requirements in equation P-1. In this equation, the number of sworn officers needed (SO) is equal to a standard ratio of sworn officers per thousand population (SO/KPOP) and the population (in thousands) in the projection year (TOTFN) taken from the demographic subsystem.

$$SO'_{t+1} = SO/KPOP_p * TOTFN_{t+1}/1000 \qquad (P\text{-}1)$$

Police officers are added in whole increments. Therefore, the total number of police officers indicated as required

(SO') is truncated by rounding down to the next lower whole number. This is indicated by the prime superscript following the variable mnemonic.

The number of additional sworn officers required is simply the change in the value of equation P-1 from the previous period to the current period. This is expressed in equation P-2 where ΔSO is the addition to the number of sworn officers.

$$\Delta SO_{t+1} = SO'_{t+1} - SO_t \qquad (P-2)$$

The total number of support personnel needed is computed as a function of the sworn officers on the force. In equation P-3, SP is the number of support personnel and SP/SO is the parametric ratio of support staff to sworn officers.

$$SP'_{t+1} = SP/SO_p * \Delta SO_{t+1} \qquad (P-3)$$

The number of supervisory personnel needed is also estimated as a function of the sworn officers. This is computed in equation P-4 where SUP is the supervisory personnel needed and SUP/SO is the parametric ratio of supervisory personnel to sworn officers.

$$SUP'_{t+1} \quad SUP/SO_p * \Delta SO_{t+1} \qquad (P-4)$$

The City of Fairfield uses community service aides for several investigatory and crime prevention activities within the Police Department. The number of community service aides (CSA) required is computed as a function of the number of sworn officers from equation P-1.

$$CSA'_{t+1} = SO_{t+1} * CSA/SO_p \qquad (P-5)$$

The number of newly added community service aides/(CSA) is calculated in equation P-6 as the change in the aides from the previous period.

$$\Delta CSA_{t+1} = CSA_{t+1} - CSA_t \qquad (P-6)$$

Equation P-7 computes the number of investigative personnel required. Police investigators are in the equation below. INV is the number of investigative personnel needed and INV/SO is the percent of sworn officers who serve as investigators.

$$INV'_{t+1} = INV/SO_p * SO_{t+1} \qquad (P-7)$$

The number of newly added investigative personnel is given by equation P-8 as the change in the investigators from the previous period and the current period.

$$\Delta INV_{t+1} = INV_{t+1} - INV_t \qquad (P-8)$$

The CRIS Police Subsystem estimates the annual salary costs for the Police Department as a product of the number of personnel in each category and the average wage rate of that employee category. The total salary costs for the Police Department are estimated as an aggregate of the salary costs for each category of employees. Equations P-9 through P-12 compute the salary costs for each category. For instance, in equation P-9, SCSO are the salary costs for sworn officers. This is estimated by multiplying the total number of sworn officers, from equation P-1, with the average wage rate for sworn officers (WRSO). Of course, the salary costs for sworn officers includes

investigators. A similar function is used to compute the salary costs for support personnel (equation P-10), supervisory personnel (equation P-11) and community service aides (equation P-12). In this equation, the average wage rate includes funds for non-salary benefits such as medical and dental insurance and retirement.

$$SCSO_{t+1} = SO_{t+1} * WRSO_p \tag{P-9}$$

$$SCSP_{t+1} = SP_{t+1} * WRSP_p \tag{P-10}$$

$$SCSUP_{t+1} = SUP_{t+1} * WRS_p \tag{P-11}$$

$$SCCSA_{t+1} = CSA_{t+1} * WRC_p \tag{P-12}$$

The total salary cost for the Police Subsystem (SCP) is computed in equation P-13.

$$SCP_{t+1} = SCSO_{t+1} + SCSP_{t+1} + SCCSA_{t+1} + SCSUP_{t+1} \tag{P-13}$$

<u>Police Capital Costs</u>

The Fairfield Police Department has no current plans for major capital investments over the projection period. Specifically, the City does not plan to construct a jail. The County is required by state law to accommodate, free of charge, all suspects involved with possible violations of California statutes; persons charged with violations of the municipal ordinances are rarely incarcerated.

However, as Cordelia and the entire Fairfield area is developed, the existing police building in the civic center complex may prove inadequate and require enlargement. Alternatively, the department may decide to construct substation facilities in the Cordelia area. But either of these events are unique circumstances which must be determined by the user.

Although the Police Department's physical plan may not require expansion, the department does have ongoing needs for capital expenditures on equipment. The patrol vehicles are replaced after 75,000 miles. This usually means that there is a complete turnover in patrol vehicles after one and a half years. Vehicles used by investigators and community service aides average 20,000 to 25,000 miles per year and are replaced at three year intervals.

The department also has several three-wheel scooters used by community service aides and parking meter persons as well as an identification van. Replacement of those vehicles are projected as part of the model. The expenditures for both replacement and operation of these auxilliary vehicles is assumed to be captured in the general expenses of the department.

The CRIS Model determines the number of new patrol cars required as a function of the number of new sworn officers

from equation P-2. Equation P-14 computes the number of new patrol cars needed (ΔPV) where VEH is a standard ratio of vehicles to sworn officers.

$$\Delta PV_{t+1} = VEH/SO_p * \Delta SO_{t+1} \qquad (P\text{-}14)$$

Equation P-15 maintains an inventory of the total number of patrol vehicles.

$$PV_{t+1} = PV_t + \Delta PV_{t+1} \qquad (p\text{-}15)$$

Similarly, the number of new investigative and community service vehicles (ΔIV) is a function of the number of new investigative and community service personnel. In equation P-16, VEH/INV is the standard ratio of vehicles to investigative personnel, ΔCSA is the number of new community service aides from equation P-6, and ΔINV is the number of new investigative personnel from equation P-8.

$$\Delta IV_{t+1} = VEH/INV_p * (\Delta CSA'_{t+1} + \Delta INV'_{t+1}) \qquad (P\text{-}16)$$

The CRIS Model maintains the inventory of investigator vehicles by summation across the previous period and the current period.

$$IV_{t+1} = IV_t + \Delta IV_{t+1} \qquad (P\text{-}17)$$

In addition to the new vehicles purchased as a result of expansion within the police force, each year the Department replaces some of its existing inventory of vehicles. The Fairfield Police Department replaces a vehicle after 75,000 miles. Under this policy, patrol vehicles are replaced at intervals of one and one-half years while investigative vehicles are replaced

every third year. Equation P-18 estimates the number of vehicles to be traded in (NVTI). In this equation, PV is the number of existing patrol vehicles and IV is the number of existing investigative vehicles.[1]

$$NVTI_{t+1} = PV_t \ / \ 1.5 + IV_t \ / \ 3 \qquad \text{(P-18)}$$

Equation P-19 estimates the trade-in value (TIV) as the product of the number of vehicles traded-in, and the average trade-in value per vehicle (TIVV). This trade-in value is exogenously established and, for simplicity, assumed constant although it can be changed by user intervention.

$$TIV_{t+1} = NVTI_{t+1} * TIVV_p \qquad \text{(P-19)}$$

Because the Fairfield Police Department replaces its existing patrol cars each year and a half, the patrol car requirements are simply the sum of the number of new vehicles required by additions to the Police Department staff (from equation P-14) and two-thirds of the number of existing patrol car vehicles (PV). Thus the total patrol car capital costs (PCC) can be computed in equation P-20 as the sum of the new patrol vehicles and two-thirds of patrol vehicles from the previous period multiplied by the parametric capital cost per car (CPC).

$$PCC_{t+1} = (\Delta PV_{t+1} + PV_t * 2/3) * CPC_p \qquad \text{(P-20)}$$

The investigative 2nd community service vehicle capital cost (IVCC) are computed in a manner similar to those for patrol car capital costs. Total number of investigative vehicles

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[1]It must be recognized that this equation will tend to slightly overestimate the number of vehicles replaced during a period of department expansion.

purchased in any year is the sum of the number of new investigative vehicles from equation P-16 and a third of the number of investigative vehicles existing in the previous period.

$$IVCC_{t+1} = (\Delta IV_{t+1} + IV_t * 1/3) * CPC_p \qquad (P-21)$$

Equation P-22 computes the total capital cost (CCP) for the Fairfield Police Department as a sum of the costs for patrol cars from equation P-20, investigative vehicles from equation P-21 and the cost of new or expanded police facilities, if any (PBCC). These costs are reduced by the value received from the vehicles traded (TIV) from equation P-21.

$$CCP_{t+1} = PCC_{t+1} + IVCC_{t+1} + PBCC_p - TIV_{t+1} \qquad (P-22)$$

Police Operating Costs

The maintenance costs for all police vehicles (MCP) is assumed to be a function of total police car mileage. As noted from the discussion above, the average patrol car logs 50,000 miles each year while investigative vehicles average 25,000 per year. Equation P-23 computes the patrol car maintenance costs (PCMC) as the function of the average annual mileage per patrol car (PCAM) and the maintenance cost per mile (MCPM). Equation P-24 uses a similar function to compute investigative vehicle maintenance cost (IVMC).

$$PCMC_{t+1} = PV_{t+1} * PCAM_p * MCPM_p \qquad (P-23)$$

$$IVMC_{t+1} = IV_{t+1} * IVAM_p * MCPM_p \qquad (P-24)$$

The total patrol car maintenance costs are computed in equation P-25 as the sum of the costs for patrol and investigative vehicles.

$$MCP_{t+1} = PCMC_{t+1} + IVMC_{t+1} \qquad \text{(P-25)}$$

Equations P-26 through P-28 compute the operating costs for police vehicles. Equation P-26 estimates patrol car operating costs (PCOC) where VC/M is the vehicle cost per mile. Equation P-27 computes the operating costs for investigative vehicles (IVOC).

$$PCOC_{t+1} = PV_{t+1} * PCAM_p * VC/M_p \qquad \text{(P-26)}$$

$$IVOC_{t+1} = IV_{t+1} * IVAM_p * VC/M_p \qquad \text{(P-27)}$$

Total vehicle operating costs (VOC) is the sum of the cost for operation of patrol cars and investigative vehicles.

$$VOC_{t+1} = PCOC_{t+1} + IVOC_{t+1} \qquad \text{(P-28)}$$

Equation P-29 computes the general operating expenses for the Police Department (POE). These are estimated as a function of the total number of sworn officers on the force. In the equation below, SO is the number of existing sworn officers, from equation P-1 and POE/SO is the standard ratio of operating expenses to total sworn officer positions.

$$POE_{t+1} = SO_{t+1} * POE/SO_p \qquad \text{(P-29)}$$

The total operating costs for the Police Department (POC) are computed as the sum of the costs for salaries (from P-13),

vehicle maintenance (from P-25), vehicle operation (from P-28), and general expenses (from P-29).

$$POC_{t+1} = SCP_{t+1} + MCP_{t+1} + VOC_{t+1} + POE_{t+1} \qquad \text{(P-30)}$$

Total Costs

Finally, total Police Department costs (TPC) are obtained by adding operating costs from equation P-30 and capital costs from equation P-22.

$$TPC_{t+1} = POC_{t+1} + CCP_{t+1} \qquad \text{(P-31)}$$

FIRE SUBSYSTEM

The fire subsystem of the CRIS Model projects two types of fire prevention and protection costs -- the capital cost for new fire stations and equipment, and the operating costs for fire protection. The CRIS fire subsystem uses standards and parameters established by officials of the City of Fairfield. As in the other CRIS subsystems, the standards implicit in the initial function parameter values are subject to change by user intervention.

Capital Costs for Fire Protection

Capital costs for the CRIS fire subsystem include expenses associated with the construction of new fire stations and the acquisition of additional fire protection equipment. The basic modeling decision in the capital cost subsection is the determination of when to build new fire stations. The problem here is to account for the human decisions which schedule the construction of fire stations.

All property in the City of Fairfield, including the Fairfield and Cordelia planning areas, can be classified into three types of fire protection planning areas (FPPAs). The first is a substation service area (SSA). An SSA is distinguished by having a fire substation located in that area.

The second classification of fire planning areas is called an extended substation service area (ESSA). An ESSA is an area that does not currently have a substation, but is contiguous with an SSA. Developments in ESSAs are temporarily provided fire protection by the personnel and equipment from the adjoining SSA.

The third classification includes areas deemed to be beyond the extended service range of existing fire stations. These areas are considered to be outside extended substation service areas (OESSA).

For planning purposes, the City of Fairfield, including the Fairfield and Cordelia planning areas, has been divided into seven fire protection planning areas (FPPAs). An FPPA is a typical area that would be served by a single fire substation. Normally, an FPPA would cover approximately 960 acres. Currently, both FPPAs in the Cordelia planning district are classified as OESSAs. In contrast, all of the Fairfield planning district (five areas) is considered to be within established or extended substation service areas, that is within SSAs or ESSAs, respectively. The FPPAs are conceptually depicted in Chart F-1 on page 137.

Current Fairfield standards are that no additional fire protection expenditures will be undertaken for areas outside of extended substation service range as long as the OESSA has less than 750 residential dwelling unit equivalents (DUE). A

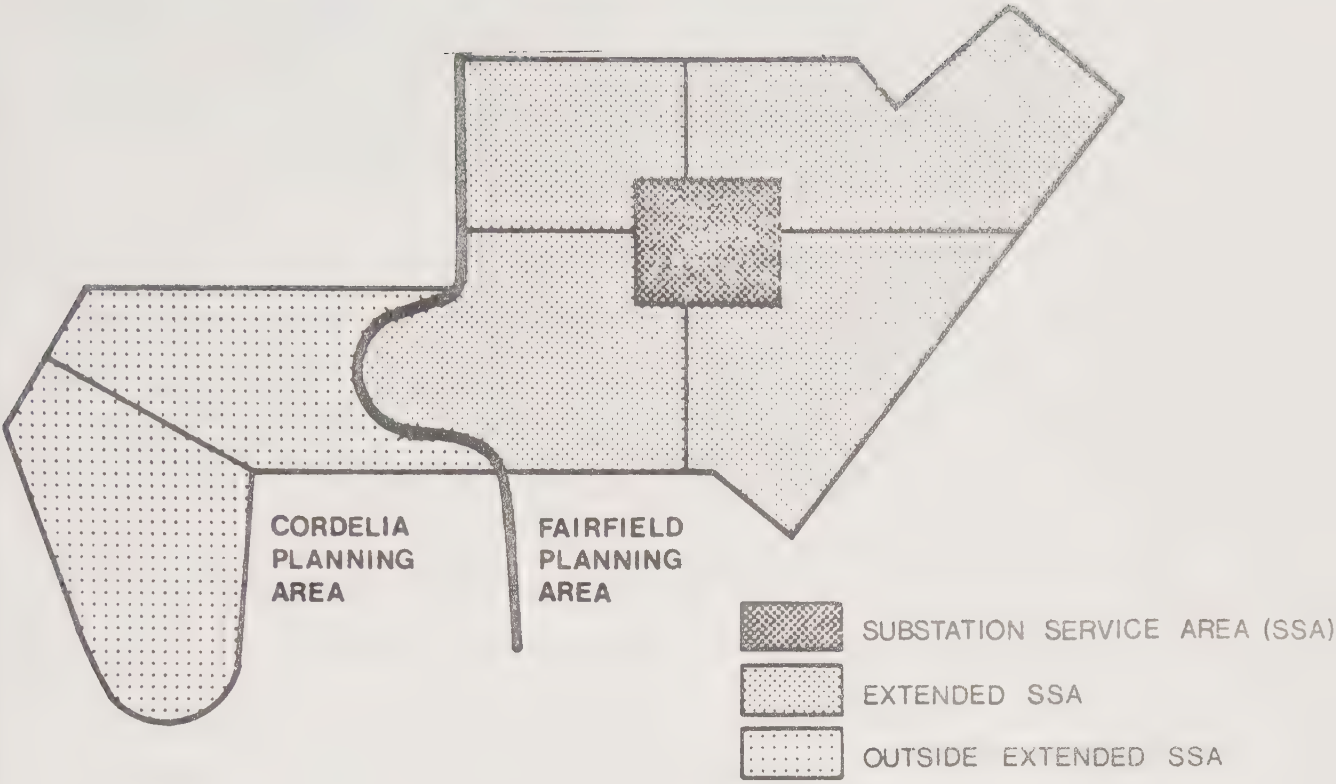


CHART F-1

dwelling unit equivalent is one dwelling unit or one-fifth of a gross acre of commercial or industrial development. This is calculated in equation F-1, where DUEC is the equivalent dwelling units in Cordelia, ΔHUC is the number of newly constructed housing units of all types, ΔDACC and ΔDAIC are the newly constructed acres of commercial and industrial units, respectively.

$$DUEC_{t+1} = DUEC_t + \sum_{k=1}^{6} \Delta HUC_{k,t+1} + (\Delta DACC_{t+1} + \Delta DAIC_{t+1}) / 5 \quad \text{(F-1)}$$

Then the Fire Subsystem determines whether the new development in the Cordelia planning area has passed the 750 DUE threshold

required for the creation of an SSA in that district. This is shown in equation F-2 where DUEC is the total number of dwelling unit equivalents in the Cordelia planning district.

$$DUEC_{t+1} \geq 750 \qquad (F-2)$$

Once the 750 DUE threshold is achieved, a new SSA is created. At that time, the FPPAs will conceptually appear as in Chart F-2 with areas contiguous to the new SSA becoming extended substation service areas (ESSAs).

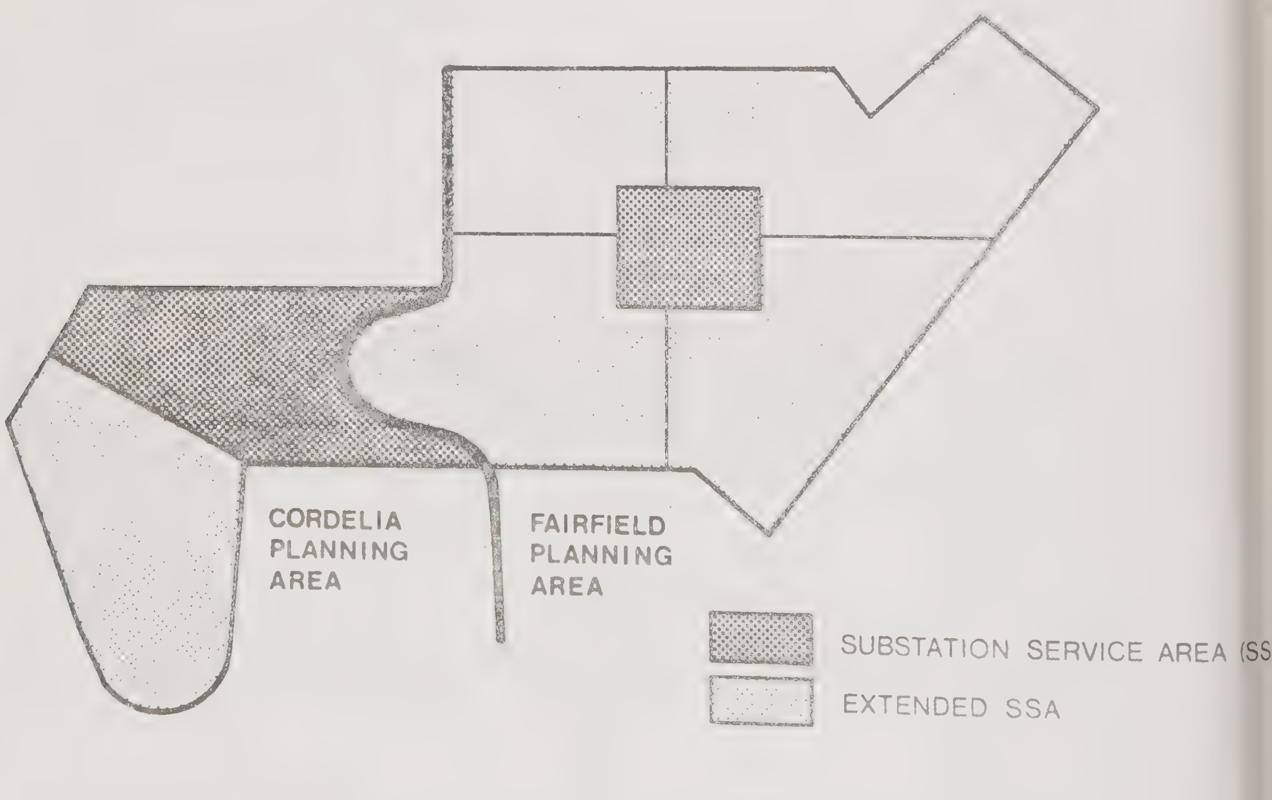


CHART F-2

The transformation of an FPPA from OESSA to SSA can only occur once as the 750 DUE threshold is reached. The conversion of an ESSA to an SSA--the decision to build another substation--depends not on the achievement of a 750 DUE threshold but on the existence of one of three conditions. These conditions, established by Fairfield officials, are based on a response-time criterion which recognizes that the time required to reach the scene of a fire will increase as an area becomes more highly developed.

The first condition is that the extended substation service area has at least 864 acres of development. This means that development would have to occur in 90% of the average 960 acres in the FPPA (.9 x 960 = 864).

The second condition is that the FPPA have at least 2765 dwelling units. This criterion is taken from the assumption that 40% of the acreage in the FPPA is developed into residences with at least 8 units per acre. This would yield an area total of 3,072 dwelling units which is reduced by 10% to 2,765 units to provide some lead time for the construction of the substation.

The third condition uses equivalent dwelling units. A dwelling unit equivalent (DUE) is, again, one dwelling unit or 1/5 acre of commercial of industrial development. According to this condition, new substation will be constructed when the FPPA has 6,912 DUEs. This assumes the 960 acre area is developed to the equivalent of

8 dwelling units per acre (960 x 8 = 7680 DUEs). This is again reduced to allow some time for substation construction (.9 x 7680 = 6,912 DUEs).

In reality, developments occur in each of the seven fire protection planning areas simultaneously and the decision to construct a substation in any one of them is made independent of the others. However, the CRIS Model is incapable of recording development at this level of detail. The model records development in only the two major planning areas--Fairfield and Cordelia. This means, for instance, that all development in the two FPPAs in Cordelia is aggregated in the model.

The problem for the model is how to relate this development to the standard established by Fairfield officials to schedule fire station construction. The amount of development in each FPPA was simply approximated by dividing the development conditions for each planning area by five and two respectively for the Fairfield and Cordelia planning areas to establish a proxy for the amount of development in each FPPA.

In the following equations, ADT is the total number of developed acres in each planning district, DUT is the total number of dwelling units in each planning district, and DUE is the number of dwelling unit equivalents for each district. The development conditions that exist in each FPPA are represented by the mnemonics ADTSAF (developed acres per service area), DUTSAF (dwelling units per service area), and DUESAF (dwelling unit equivalents per

service area) in the Fairfield planning area. Equations F-6 through F-8 estimate the current development conditions in the FPPAs in the Cordelia planning area. ADTSAC, DUTSAC, AND DUESAC represent the degree of development in each substation service area in Cordelia.

$$ADTSAF_{t+1} = ADTF_{t+1} / 5 \qquad (F-3)$$

$$DUTSAF_{t+1} = DUTF_{t+1} / 5 \qquad (F-4)$$

$$DUESAF_{t+1} = DUEF_{t+1} / 5 \qquad (F-5)$$

$$ADTSAC_{t+1} = ADTC_{t+1} / 5 \qquad (F-6)$$

$$DUTSAC_{t+1} = DUTC_{t+1} / 5 \qquad (F-7)$$

$$DUESAC_{t+1} = DUEC_{t+1} / 5 \qquad (F-8)$$

The next operation of the CRIS Model tests the degree of development in each service area against the three conditions or criteria required for construction of a fire substation. This test is performed for all five FPPAs in each planning district in equations F-9 through F-14 below.

$$ADTSAF_{t+1} \geq ADTSAFP_p \qquad (F-9)$$

$$DUTSAF_{t+1} \geq DUTSAFP_p \qquad (F-10)$$

$$DUESAF_{t+1} \geq DUESAFP_p \qquad (F-11)$$

$$ADTSAC_{t+1} \geq ADTSACP_p \qquad (F-12)$$

$$DUTSAC_{t+1} \geq DUTSACP_p \qquad (F-13)$$

$$DUESAC_{t+1} \geq DUESACP_p \qquad (F-14)$$

If any one of the estimates of development in the FPPAs of the Fairfield or Cordelia planning districts exceeds the standard parametric condition required for development, then a fire substation (ΔFSS) is constructed. However, because there are five FPPAs in the Fairfield planning district, for example, this method would tend to delay construction of substations until the parameter was equaled or exceeded and then build all five at once. This is obviously unrealistic. First, the development is not likely to be evenly distributed among the FPPAs, but rather concentrated on one or two of them. Thus a natural staging of the station construction is to be realistically expected. Second, fire stations constitute a major capital expenditure and the City of Fairfield will, to the extent feasible, avoid this major expense for more than one station in a single year.

In order to achieve this staging of the fire station construction in the CRIS Model, the parameters for each planning district are adjusted as stations are constructed. The adjustments are made in accordance with the schedule in the following table for the five Fairfield stations and the two in Cordelia.

ORDER OF SUBSTATION CONSTRUCTION IN EACH PLANNING AREA	CONDITIONS IN EACH SUBSTATION SERVICE AR			
	(FACTOR)	ADT	DUT	DUE
First	(1.0)			750
Second	(1.2)	1152	3686.4	9216
Third	(1.4)	1344	4300.8	10752
Fourth	(1.6)	1536	4915.2	12288
Fifth	(1.8)	1728	5529.6	13824

The capital costs associated with the construction of a fire substation are the actual construction cost for the station building and the cost of the equipment required for that facility.

Equation F-15 computes the total capital cost for the fire subsystem (FCCT) as the sum of the costs for the substation (FCSS) and the fire-fighting equipment (FCCE) times the number of substations constructed in any one year (ΔFSS). The capital costs for both the station and the equipment are parametric values in the model and are initially assumed to remain constant. The City of Fairfield does not issue bonds to pay for the capital expenditures of the fire department. These costs are paid out of the general fund as incurred.

$$FCCT_{t+1} = (FCCS_p + FCCE_p) * \Delta FSS_{t+1} \tag{F-15}$$

<u>Operating Costs for Fire Protection</u>

The operating costs of the Fairfield fire department depend on the number of fire substations and the number of fire trucks. In the CRIS Model, these costs are disaggregated into three components: (1) fire operating costs for the fire crew (FOCR), (2) fire maintenance costs (FMC), and (3) fire headquarters cost (FHQC).

Manpower costs for the fire department are assumed to be directly related to the number of fire trucks. Thus, additions to the stock of fire trucks will result in increases in the operating costs for manpower. Equation F-16 calculates the additional fire

trucks needed to serve new fire substations (ΔFT). This is computed on the basis of the number of new fire substations number of new fire substations (ΔFSS) and the average number of trucks per station (FT/FSS).

$$\Delta FT_{t+1} = \Delta FSS_{t+1} * FT/FSS_p \qquad \text{(F-16)}$$

Equation F-17 maintains a record of the inventory of fire trucks. The number of fire trucks in any year (FT) is the total of the trucks in the previous year and the number of fire trucks purchased in the present year (ΔFT).

Each fire substation, excluding the main station, is assumed to have one pumper-fire truck. The headquarters station has specialized fire fighting equipment which is dispatched as necessary throughout the City. According to the standards used by the Fire Department each truck is expected to remain in service for approximately 30 years. If the City adheres to this standard none of the existing fire trucks will require replacement during the projection period.

$$FT_{t+1} = FT_t + \Delta FT_{t+1} \qquad \text{(F-17)}$$

Equation F-18 translates the inventory of fire trucks into the associated manpower costs. Here FOCR is a function of the number of fire trucks (from F-17) and the manpower costs per fire truck (MPC/FT). This parameter is entirely dependent upon existing salary scale including non-salary benefits for pension and medical coverage for a nine-person fire truck crew (three shifts of three each).

$$FOCM = FT_{t+1} * MPC/FT_p \qquad \text{(F-18)}$$

In a similar manner, the maintenance costs for the fire subsystem are calculated as a function of the number of fire stations. Equation F-19 calculates the number of fire substations (FSS) as the sum of the substations existing in the previous year and the number constructed in the current year.

$$FSS_{t+1} = FSS_t + \Delta FSS_{t+1} \tag{F-19}$$

Maintenance costs for the fire substations (FMC) are computed as a function of the number of stations (from F-19). The cost for maintenance per fire substation (MC/FSS) is estimated to be constant for all stations and is a parameter in the model.

$$FMC_{t+1} = FSS_{t+1} * MC/FSS_p \tag{F-20}$$

The City of Fairfield budgets for the maintenance and operation of the department's fire trucks on the basis of the number of trucks. The CRIS Model also assumes that the maintenance and operation costs are a function of the number of trucks. These costs are computed in the following equation where FTC is the annual cost for all fire trucks and FTC/FT is the average cost per truck.

$$FTC_{t+1} = FT_{t+1} * FTC/FT_p \tag{F-21}$$

The fire headquarters and miscellaneous operating costs (FHQC) represent the cost for existing headquarters staff and auxiliary equipment of the Fairfield fire department. It is anticipated by Fairfield that these costs will remain constant despite development in either the Fairfield or Cordelia planning districts and

the expansion of the fire department. Therefore, the value of this variable is set in the model. However, if development in the Fairfield or Cordelia planning areas calls to question this assumption of constant headquarters costs, the value of this variable can be reset by user intervention.

Equation F-22 computes the total operating costs (FCO) for the fire subsystem. Here, FOCR is the cost of the fire crew from equation F-18, FMC is the maintenance cost from equation F-20 and FHQC is the additional cost for the department headquarters.

$$FCO_{t+1} = FOCR_{t+1} + FMC_{t+1} + FHQC_{p} \tag{F-22}$$

The total cost for the Fairfield Fire Department (FCT) is computed in equation F-23 as the sum of the capital and operating costs.

$$FCT_{t+1} = FCCT_{t+1} + FCO_{t+1} \tag{F-23}$$

SEWER SUBSYSTEM

At the time the City of Fairfield was incorporated, wood-box sewers discharged effluent directly into Suisun Marsh. In 1907 the City installed the first sewage treatment plant. This rudimentary facility served the City for many years. However, following World War II studies of existing facilities and conditions suggested a regional sewage system to solve the treatment and disposal problems of both Fairfield and Suisun City. Subsequently, the Fairfield-Suisun Sewer District was formed.

The Fairfield-Suisun Sewer District is a special district which includes all territory within the cities of Fairfield and Suisun. The District is, and must remain, coterminus with the boundaries of the two cities. The District is governed by a ten member board of directors consisting of the five city council members in each city.

According to the enabling agreements, the District may operate wastewater collection, treatment and disposal systems and stormwater collection and disposal systems inside or outside the District. Currently, the treatment and disposal facilities are operated by the District. However, the collection systems within each city are maintained by the respective cities under a reimbursement agreement with the District.

At present, there is one sewage treatment plant operating in the Fairfield/Suisun area. In 1977, the City of Fairfield completed construction of a 10.35 mgd tertiary treatment sewer plant. The plant includes such auxiliary facilities as pumpting systems and trunk sewer lines. This plant, which is owned by the City, is leased to the Fairfield-Suisun Sewer District. The District is responsible for operation of the plant. It is expected that the subregional plant will be expanded to meet all future demands for sewage treatment. The plant is designed to ultimately accommodate a capacity of 30 mgd.

The Sewer Subsystem calculates two types of costs--capital and operating. The operating costs are computed primarily on the basis of volume of sewage processed in the plant. The capital costs are calculated to repay the bonds necessary to finance construction of the treatment plant and its appurtenances. As additional treatment plant capacity is needed and the facilities are expanded, additional bonds are issued and the capital costs increase. These plant expansions are timed in the model by comparing projected demands for sewage treatment with the existing treatment capacity of the plant.

Projected Treatment Demand and Capacity

The first operation of the Sewer Subsystem is to compute the projected demand for sewage treatment. This demand is measured in millions of gallons per day. The number of gallons demanded

is computed separately for single- and multi-family housing units and for commercial and industrial developments. Special sewage demands, such as that for schools and the City of Suisun City, are also computed separately.

Demand From Housing Development

The CRIS Model divides housing units into six categories. Categories are determined by the type of housing unit, i.e., single-family or multi-family and the number of bedrooms contained within that housing type. The six housing categories are outlined in Table S-1.

TABLE S-1

Housing Categories

Housing Category	Housing Type	Number of Bedrooms
1	Single Family	2
2	Single Family	3
3	Single Family	4+
4	Multi-Family	0-1
5	Multi-Family	2
6	Multi-Family	3+

The CRIS Model computes the number of newly occupied housing units separately for the Fairfield and Cordelia planning areas. These calculations are made in equations D-25 through D-36 of the Demographic Subsystem. In the Sewer Subsystem the number of newly occupied housing units must be aggregated across both planning areas and computed separately for single and multi-family units. The

number of newly occupied single-family housing units ($\Delta HUSF$) is calculated in equation S-1. The computation is made by summing across all single-family housing categories (from Table S-1) for newly developed, newly occupied units in the Fairfield planning area (ΔHUF) and similar units in the Cordelia planning area (ΔHUC). The k subscript to the mnemonics indicates the housing category as this is incremented across bedroom classifications.

$$\Delta HUSF_{t+1} = \sum_{k=1}^{3} (\Delta HUF_{k,t+1} + \Delta HUC_{k,t+1}) \tag{S-1}$$

Similarly, the number of newly occupied multi-family units ($\Delta HUMF$) is computed as the sum of newly occupied multi-family housing units (housing categories 4, 5 and 6) in each planning area. In equation S-2 the number of newly occupied multi-family housing units in Fairfield is represented by the subscripted mnemonic ΔHUF and those in the Cordelia area by the mnemonic ΔHUC.

$$\Delta HUMF_{t+1} = \sum_{k=4}^{6} (\Delta HUF_{k,t+1} + \Delta HUC_{k,t+1}) \tag{S-2}$$

The total of all occupied single-family housing units ($HUSF$) is the sum of the newly occupied units ($\Delta HUSF$) and the occupied units from the previous period. This computation is made in equation S-3 below.

$$HUSF_{t+1} = HUSF_{t} + \Delta HUSF_{t+1} \tag{S-3}$$

The total of all occupied multi-family housing units (HUMF) is computed in equation S-4 as the sum of the newly occupied mutli-family units (ΔHUMF) and the previously occupied units.

$$HUMF_{t+1} = HUMF_{t} + \Delta HUMF_{t+1} \tag{S-4}$$

Sewage treatment demand is based on the number of occupied housing units. The gallons per day demanded from single-family dwellings (GDSF) is calculated in equation S-5. Here, the number of occupied single-family housing units (HUSF) is multiplied by the parametric average gallons of sewage treatment demanded each day for a single-family unit (GD/SF).

$$GDSF_{t+1} = HUSF_{t+1} * GD/SF_{p} \tag{S-5}$$

Similarly, the total gallons of treatment demanded by multi-family (GDMF) is calculated in equation S-6 as the product of the multi-family units (HUMF) and the parametric average demand per multi-family unit (GD/MF).

$$GDMF_{t+1} = HUMF_{t+1} * GD/MF_{p} \tag{S-6}$$

Demand From Commercial Development

Demand for sewage treatment by commercial developments is estimated on the basis of the total number of acres of such development. In this case the average commercial acre generates 1,350 gallons per day of sewage. Equation S-7 calculates the increase in sewage

demand from new commercial development (ΔGDC) by multiplying the number of new commercial acreage developed in a year (ΔCA) by average sewage demand per commercial acre (GD/CA).

$$\Delta GDC_{t+1} = \Delta CA_{t+1} * GD/CA_{p} \tag{S-7}$$

Equation S-8 computes the total demand for sewage treatment for commercial development (GDC) as the sum of the demand from commercial development in the previous period and the sewage treatment demand from new commercial development (ΔGDC).

$$GDC_{t+1} = GDC_{t} + \Delta GDC_{t+1} \tag{S-8}$$

Demand From Industrial Development

The demand for sewage treatment from industrial development is disaggregated into two categories: light and heavy industries. The demand from light industry is calculated in a manner similar to commercial demand on the basis of the number of acres of light industrial development. On the average, light industry generates 1,800 gallon per day of sewage demand per developed acre. Thus, in equation S-9, the demand for sewage treatment from new light industrial development ($\Delta GDLI$) is calculated by multiplying the newly developed light industrial acreage (ΔLIA) times the parametric demand per light industrial acre (GD/LIA).

$$\Delta GDLI_{t+1} = \Delta LIA_{t+1} * GD/LIA_{p} \tag{S-9}$$

Total demand for sewage treatment from light industrial development (GDLI) is calculated in equation S-10 as the sum of the demand in the previous period and the demand from newly developed light industry.

$$GDLI_{t+1} = GDLI_{t} + \Delta GDLI_{t+1} \qquad \text{(S-10)}$$

Development of heavy industry is not projected as part of the CRIS Model. Heavy industrial development is episodic and is therefore taken as input directly from the development schedules. Moreover, the demand for sewage treatment from heavy industry varies considerably with the nature of the industry involved. Thus, the demand for sewage treatment from new heavy industrial development (ΔGDHI) is an input taken directly from the development schedule for each year. Equation S-11 calculates the total demand for sewage treatment from heavy industrial development (GDHI) as the sum of the demand from the previous period and the new demand input.

$$GDHI_{t+1} = GDHI_{t} + \Delta GDHI_{t+1} \qquad \text{(S-11)}$$

Special Sewage Demands

The demand for sewage treatment generated by schools in the Fairfield-Suisun area, is computed as a special case in the CRIS Model. Equation S-12 calculates the total demand for sewage treatment from schools (GDS) as a function of the total school enrollment. Generally, the treatment demand from the school system averages thirty gallons per student per day. The demand is calculated by

summing the enrollment in both planning areas over all grade categories and multiplying by the parametric demand per student day (GD/STUD). In the following equation, ENRF is the school enrollment from the Fairfield planning area (from equation E-30 through E-32) and ENRC is the school enrollment from the Cordelia planning area (from equations E-33 throught E-35). The "j" subscript indicates the grade category as shown in Table D-3.

$$GDS_{t+1} = \left(\sum_{j=1}^{3} \left(ENRF_{j,t+1} + ENRC_{j,t+1}\right)\right) \quad \text{(S-12)}$$

$$* \ GD/STUD_{p}$$

In addition to the treatment of sewage generated within the District, the subregional plant also treats sewage from areas outside the boundaries of the District. The demand for treatment from "outside" areas is calculated on the basis of the number of acres served. Equation S-13 calculates the total developed acres outside the boundary of the District which may be served by the sewage treatment plant (OA). This is computed as the sum of the existing acreage and the parameter representing newly developed acres (ΔOA)

$$OA_{t+1} = OA_{t} + \Delta OA_{p,t+1} \quad \text{(S-13)}$$

In equation S-14, the gallons demanded from outside areas (GDOA) is computed from the multiplication of the average gallons demanded

per outside acre (GD/OA) and the acres served (OA). Another factor is included in the equation to allow for the case where the demands from a particular area are either known or can be predicted with particular accuracy. In the general case, however, the value of this parameter for the "known" demand from outside areas (GDOK) is set at zero.

$$GDO_{t+1} = (OA_{t+1} * GD/OA_p) + GDOK_p \qquad (S-14)$$

The District's subregional plant is not specifically designed to treat urban stormwater runoff. However, the system can treat peak volumes of approximately 16 mgd for short periods. Like most municipal treatment plants, the facility receives large volumes of flow during periods of precipitation. The stormwater flow is the result of the infiltration of runoff into the municipal collector system. This stormwater flow can be seen as a demand on the sewage system in that it displaces treatment capacity which could be reserved for other consumers of sewage services. This demand from surface runoff or stormwater infiltration is a function of several factors including: the age of the collector systems, the amount of impervious surfaces, the rate of percolation in the soil, the number of cross-connections between the municipal sewage system and the stormwater system, the number of trees whose roots may break the collector pipes, the extent of the total collector system, and the frequency of large rain storms. For simplicity, the gallons of treatment capacity by surface runoff is computed from the miles

of sewage pipe in the collector system.

It can safely be assumed that newly installed sewer pipe will not leak. Therefore, for purposes of this calculation the newly installed pipe is not considered. The length of sewer pipe subject to infiltration is the total miles of sewer pipe (MSP) from the previous period. (See equations S-24 through S-26.)

With the total miles of sewer pipe subject to infiltration known, the increased flow resulting from infiltration of surface runoff can be determined by application of an impirically determined infiltration rate per mile of pipe. Therefore, the total gallons of sewage treatment capacity which must be reserved for flow increases due to surface runoff infiltration (GDSR) is the product of the miles of sewer pipe (MSP) and a factor representing the average infiltration rate per mile of pipe (IR/MSP). Initially, the value of this parameter is set at zero.

$$GDSR_{t+1} = (MSPR_t + MSPC_t + MSPI_t) * IR/MSP_p \qquad (S\text{-}15)$$

The gallons of sewage treatment demanded by the residents of Suisun City (GDSC) is assumed in the CRIS Model to be a direct function of the population of the City. Equation S-16 computes the demand from Suisun in the current period by factoring the demand from the previous period by the known growth rate of the Suisun City population (GROWS), This growth rate parameter is taken from

equation D-72.

$$GDSC_{t+1} = GDSC_{t} * GROWS_{p} \qquad (S-16)$$

The total demand for sewage treatment (GD) is computed in equation S-17 as the sum of the demand from single-family housing units (GDSF), multi-family housing units (GDMF), commercial acreage (GDC), light industrial acreage (GDLI), heavy industrial development (GDHI), schools (GDS), outside areas (GDOA), surface runoff (GDSR), and the population of Suisun City (GDSC).

$$GD_{t+1} = GDSF_{t+1} + GDMF_{t+1} + GDC_{t+1} + GDLI_{t+1} \qquad (S-17)$$

$$+ GDHI_{t+1} + GDS_{t+1} + GDOA_{t+1} + GDSR_{t+1}$$

$$+ GDSC_{t+1}$$

Sewage Treatment Plant Capacity

The next operation of CRIS Model tests the total demand for sewage treatment from equation S-17 against the existing capacity (EXCAP) of the treatment plant. The existing capacity is measured in millions of gallons per day (MGD). The existing treatment plant has a maximum capacity of 10.35 mgd. In order to allow sufficient lead time for the construction of additional capacity, the design capacity is factored by a parameter (SCLT) to reduce the capacity considered for this test. The sewer construction lead time parameter will always be less than or equal to one.

$$GD_{t+1} \leq EXCAP_t * SCLT_p \qquad (S-18)$$

If the condition in S-18 is sustained, no additional capcity is required to accommodate the new demand for sewage treatment. However, if the condition is violated, and the demand exceeds the existing capacity, then additional sewage treatment capacity (ΔCAP must be constructed.

$$EXCAP_{t+1} = EXCAP_t + \Delta CAP_p \qquad (S-19)$$

Sewer Capital Costs

The core of the existing subregional treatment facility has a design capacity of 30 mgd. The initial treatment capacity of the plant was limited to 10.35 mgd. The treatment plant was designed so that as this initial capacity limit was reached an additional 5 mgd capacity increment could be added. Eventually, as sewage treatment demand increases, the capacity limit of the expanded (15.35 mgd) plant will be reached. At this point, the plant desig calls for the addition of new facilities to increase the plant capacity to the full 30 mgd capacity maximum. The cost for each increment of increased capacity ($\Delta CAPC$) is listed in Table S-2 bel

TABLE S-2

Capital Costs for Increases in

Sewage Treatment Capacity

Order	ΔCAP	$\Delta CAPC$
First	5 mgd	$4 mil
Second	15 mgd	$12 mi

If the decision is made in the model to increase plant capacity by a unit of ΔCAP, capital cost of that decision is taken directly from the table. The District has decided to finance the capital cost from revenue bonds. Therefore, the next operation of the Model is to amortize the capital costs over the twenty-five year bonding period. Equation S-20 computes the total increased payment ($\Delta TPMTS$) as a result of the increased capital cost. In this equation BIS is the bond interest rate and the bond payment period is twenty-five years.

$$\Delta TPMTS_{t+1} = \Delta CAPC_{t+1} + (\Delta CAPC_{t+1} * BIS) \qquad (S-20)$$

$$/ (1 - (1 + BIS) ** (-25))$$

In equation S-20, the mnemonic $\Delta TPMTS$ represents the total payment for principal and interest over the life of the new sewer bonds. The following equation approximates the annual payments ($\Delta PMTS$) by dividing the total payments over the payment period.

$$\Delta PMTS_{t+1} = \Delta TPMTS_{t+1} / 25 \qquad (S-21)$$

The value in equation S-21 is used to revise the sewer bond payment schedule. It is from this schedule that the total capital costs for any year are derived. Equation S-22 updates the annual sewer bond payment schedule (PMTS) by adding the annual payment associated with sewage treatment plant expansion ($\Delta PMTS$).

$$PMTS_{t+1} = PMTS_{t+1} + \Delta PMTS_{t+1} \tag{S-22}$$

Sewer Plant Operating Cost

The total operation and maintenance cost for the subregional sewage treatment plant includes both fixed and variable costs. The fixed costs are those associated with the maintenance of the physical plant irrespective of the amount of sewage treated. The variable costs for treatment operation are a direct function of the changes in sewage volume. The following equation (S-23) calculates the fixed cost of the sewage treatment plant (PLFC) by multiplying the plant capacity (EXCAP) by the parametric costs per increment of capacity (C/XCAP) and including the cost of contracts for special services at the treatment facility (SPKC). In the case of the Fairfield plant, all the costs--fixed and variable--are covered by a contract with a consultant firm which operates the plant for the Fairfield-Suisun Sewage District.

$$PLFC_{t+1} = EXCAP_{t+1} * C/XCAP_p + SPKC_p \tag{S-23}$$

The variable costs of sewage plant operation (PLVC) are estimated in the general case in Equation S-24. Where GD is the gallons of sewage treatment demanded from Equation S-17, and VC/GD is the average cost of treating a million gallons of sewage at the Fairfield plant.

$$PLVC_{t+1} = GD_{t+1} * VC/GD_p \tag{S-24}$$

The total operation and maintenance cost of the sewage treatment plant (PLOMC) is calculated in Equation S-25 as the sum of the fixed variable costs.

$$PLOMC_{t+1} = PLFC_{t+1} + PLVC_{t+1} \tag{S-25}$$

<u>Sewer Pipe Maintenance Cost</u>

According to the incorporating agreements of the Fairfield-Suisun Sewage District, each city is responsible for maintenance of the sewer pipes within their city limits. The cities are reimbursed by the District for the costs of maintaining these pipes. For the City of Fairfield, the cost of sewer pipe maintenance can be estimated on the basis of the extent of the sewage collector system.

Each year the sewage collection system is extended to serve new developments. The amount of sewer pipe installed as a result of development is taken as input directly from the development schedules (see Appendix A). The development schedules disaggregate sewer pipe into three types depending on the diameter of the pipe. The categories of sewer pipe are shown in the following table.

<u>TABLE S-3</u>

Sewer Pipe Categories

Category	Diameter
Type 1	$<$ 12 inch
Type 2	12 inch
Type 3	$>$ 12 inch

Sanitary Sewer System

The first operation in the computation of sewer pipe maintenance cost is to estimate the extent of the sewer system as measured in miles of sewer pipe (MSP). The following equation calculates the miles of sewer pipe installed to serve residential development (MSPR) as the sum of the sewer pipe installed in the current period (ΔSPR) for each type of pipe and the pipe installed during previous periods. Length of the newly installed pipe (measured in feet) is taken directly from the residential development schedule. The type of pipe is indicated by the subscript "m."

$$MSPR_{m,t+1} = MSPR_{m,t} + (\Delta SPR_{m,t+1} * 1/5280) \qquad \text{(S-26)}$$

The following set of equations calculates the miles of sewer pipe from the commercial development schedule (MSPC) and industrial development schedule (MSPI).

$$MSPC_{m,t+1} = MSPC_{m,t} + (\Delta SPC_{m,t+1} * 1/5280 \qquad \text{(S-27)}$$

$$MSPI_{m,t+1} = MSPI_{m,t} + (\Delta SPI_{m,t+1} * 1/5280 \qquad \text{(S-28)}$$

Equation S-29 computes the total miles of each type of sewer pipe within the City of Fairfield (MSP) as the sum of the miles of sewer pipe from residential (MSPR), commercial (MSPC), and industrial (MSPI) development.

$$MSP_{m,t+1} = MSPR_{m,t+1} + MSPC_{m,t+1} + MSPI_{m,t+1} \qquad (S-29)$$

The total miles of all types of sewer pipe (MSPT) is computed in equation S-30 as the sum of the pipe from each category.

$$MSPT_{t+1} = \sum_{m=1}^{3} MSP_{m,t+1} \qquad (S-30)$$

With the total miles of sewer pipe computed, the sewer pipe maintenance costs can be determined by application of an impirically established average annual cost per mile of pipe. In the following equation, SPMC represents the sewer pipe maintenance cost. MSPT is the total miles of sewer pipe (from equation S-30), and MC/MSP is the average costs per mile of pipe. Only a single value is used for the parameter because the average cost of sewer pipe maintenance does not seem to vary significantly for each type of sewer pipe. The existing sewer pipe mileage is used in this calculation because it is assumed that the newly installed pipe will not require immediate maintenance.

$$SPMC_{t+1} = MSPT_{t} * MC/MSP_{p} \qquad (S-31)$$

Storm Sewer System

Storm sewer pipes are also installed when an area is developed. Basically, there are two types of storm sewer pipes as shown in Table S-4 on the following page.

TABLE S-4

Storm Sewer Pipe Categories

Category	Diameter
Type 1	$\leq$ 36 inch
Type 2	> 36 inch

The extent of the storm sewer system is calculated in a manner similar to that for the sanitary sewer system. The following equation computes the miles of storm pipe for residential development (MSTPR) for each type of pipe. This is the sum of the existing miles of storm pipe and the newly installed storm sewer pipe (ΔSTPR) from the development schedule. The type of pipe is indicated by the "u" subscript.

$$MSTPR_{u,t+1} = MSTPR_{u,t} + (\Delta STPR_{u,t+1} * 1/5280) \qquad (S-32)$$

The following set of equations calculate the miles of sewer pipe within each category for commercial and industrial development (MSTPC and MSTPI, respectively).

$$MSTPC_{u,t+1} = MSTPC_{u,t} + (\Delta STPC_{u,t+1} * 1/5280) \qquad (S-33)$$

$$MSTPI_{u,t+1} = MSTPI_{u,t} + (\Delta STPI_{u,t+1} * 1/5280) \qquad (S-34)$$

Equation S-35 computes the total miles of each type of storm sewer pipe within the City of Fairfield (MSTP) as the sum of the miles of storm pipe from residential (MSTPR), commercial (MSTPC), and industrial (MSTPI) development.

$$MSTP_{u,t+1} = MSTPR_{u,t+1} + MSTPC_{u,t+1} + MSTPI_{u,t+1} \qquad \text{(S-35)}$$

The total miles of all types of storm sewer pipes (MSTPT) is computed in equation S-36 as the sum of the pipe from each category.

$$MSTPT_{t+1} = \sum_{u=1}^{2} MSTP_{u,t+1} \qquad \text{(S-36)}$$

The maintenance costs for storm sewers (STPMC) are computed in equation S-37 by application of the empirically derived average annual cost per mile of storm pipe (MC/MSTP).

$$STPMC_{t+1} = MSTPT_{t} * MC/MSTP_{p} \qquad \text{(S-37)}$$

The total sewer pipe maintenance costs (TSPMC) is calcuated in equation S-38 as the sum of the costs for the sanitary sewer system (SPMC) and the storm sewer system (STPMC).

$$TSPMC_{t+1} = SPMC_{t+1} + STPMC_{t+1} \qquad \text{(S-38)}$$

Sewer System Revenue

The revenues from operation of the sewer system accrue to both the City of Fairfield and the Fairfield-Suisun Sewer District. The

City has four sources of revenue associated with the operation and maintenance of the sewer system--payment of rent from the District for use of the treatment plant, reimbursement for the cost of maintaining sewer pipes 12 inches or larger, a fee for billing sewage customers, and industrial stand-by charges. The sources of revenue for the District are the service charges to customers, connection charges, and a main extension charge.

City Revenue

According to the contract between the District and the City, the district agrees to pay rent for the use of the sewage treatment plant. The base rent is equal to the remainder of interest and principal due on the bonds during the following calendar year less the annual amount received directly by the City in industrial stand-by charges.

The industrial stand-by charge is a fee that large industries must pay to purchase capacity of the sewage treatment plant. Each new industry is charged a fee based on the initial cost of the plant. Currently, this fee is $2.365 per gallon of daily sewage provided there are no peaks in the effluent discharges. If the discharges of industrial effluent peak at certain times of the day the effluent is stronger than normal domestic discharges, the charge is dependent upon the strength (biological and chemical oxygen demand or toxicity) of the sewage.

The following equation calculates the revenue to the City from the sewer plant rental payment (SPRNT) by subtracting any industrial stand-by charges (ISBC) from the payment on principal and interest on the sewer bonds (PMTS).

$$SPRNT_{t+1} = PMTS_{t+1} - ISBC_{p} \qquad (S\text{-}39)$$

Fairfield's second source of revenue from operation of the sewage system is maintenance of the sewer pipes leased to the District. Those lines with a diameter of 12 inches or larger are maintained by the District. The City maintains all of the sewer pipes but the District must reimburse the City for the cost of maintenance on the leased pipes.

The following equation computes the amount of the City's indemnification for sewer line maintenance (SPMF). This is calculated by multiplying the sum of the miles of large sewer pipes (MSP) by the annual fee per sewer pipe mile (F/MSP).

$$SPMF_{t+1} = \left(\sum_{m=2}^{3} MSP_{m,t+1}\right) * F/MSP_{p} \qquad (S\text{-}40)$$

The third source of sewage operation revenue for the City of Fairfield is the sewage service billing retainer. The City finance department handles the billing of customers of the District's sewage service. For this billing service and other administrative activities the City retains a portion of the fees collected. Presently, the City's retention rate is 8%.

Equation S-41 calculates the sewage service billing retainer (SSBR) by multiplying the total gallons of sewage treatment demanded (GD) by the fee per gallon (F/GD) and the City's retention rate (CRR).

$$SSBR_{t+1} = GD_{t+1} * F/GD_{p} * CRR_{p} \qquad (S-41)$$

Fairfield's total revenue from the operation of the sewage treatment plant (SPOR) is computed in equation S-42 as the sum of the rental payment (SPRNT), the sewer pipe maintenance fee (SPMF), the sewage service billing retainer (SSBR), and the industrial stand-by charges.

$$SPOR_{t+1} = SPRNT_{t+1} + SPMF_{t+1} + SSBR_{t+1} + ISBC_{t+1} \qquad (S-42)$$

District Revenue

As noted earlier, the Fairfield-Suisun Sewer District has three sources of revenue. The first is the revenue from service charges. These charges are collected by the City of Fairfield and remitted to the District, less the amount retained by the City for billing and collection. The following equation computes the District's sewer service charge revenue (SSCR) by multiplying the total gallons of sewage treatment demanded (GD) and the fee per gallon (F/GD). This product is factored by the amount retained by the City.

$$SSCR_{t+1} = GD_{t+1} * F/GD_{p} * (1 - CRR_{p}) \qquad (S-43)$$

The District's second source of revenue is the charge for each new connection to the sewage collection and treatment system. The sewer service connection charge (SSCC) is collected at the time the construction permits are issued. The total connection charges are calculated as the sum of the connections for residential, commercial, and industrial development (ΔRSSC, ΔCSSC, and ΔISSC, respectively) each multiplied by the appropriate connection rate (RSR, CSR, and ISR, respectively).

$$SSCC_{t+1} = (RSSC_{t+1} * RSR_{p}) + (\Delta CSC) * CSR_{p} + (\Delta ISC) * ISR_{p}) \qquad (S-44)$$

The District's third source of revenue is the sewer main extension charge (SMEC). If the District must extend any sewer main or large sewage collection pipe to serve a particular development, the developer is required to pay the cost of this extension. The sewer main extension charge is taken directly as input from the development schedules. In the following equation, SMECR is the sewer main extension charge for residential development and SMECC and SMECI are the charges of commercial and industrial development, respectively.

$$SMEC_{t+1} = SMECR_{t+1} + SMECC_{t+1} + SMECI_{t+1} \qquad (S-45)$$

The total revenue for the sewer district (SDTR) is calculated as the sum of the revenue from the sewer service charges (SSCR), the

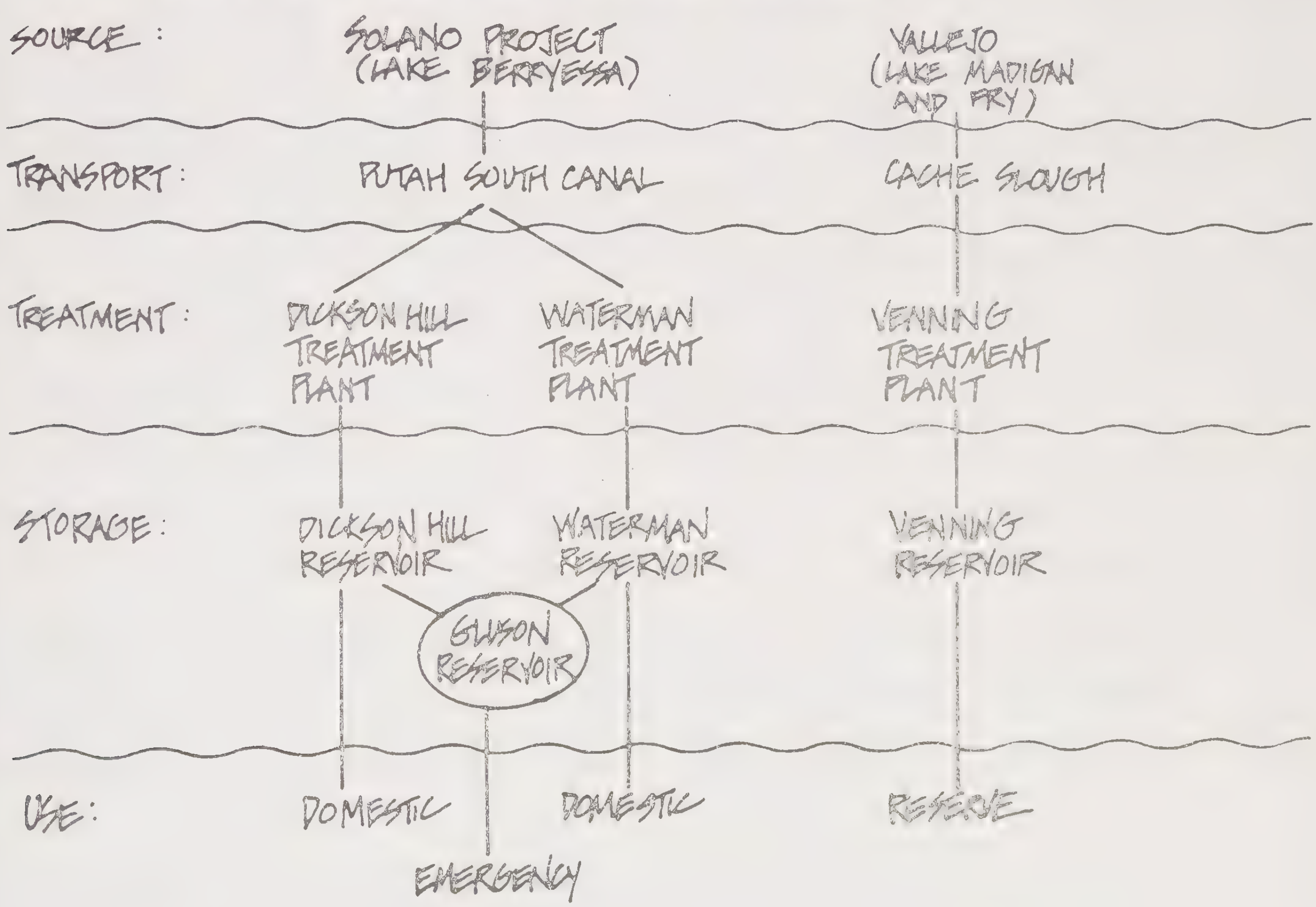
sewage service connection charge (SSCC), and the sewer main extension charge (SMEC).

$$SDTR_{t+1} = SSCR_{t+1} + SSCC_{t+1} + SMEC_{t+1} \qquad (S-45)$$

WATER SUBSYSTEM

The City of Fairfield has owned and operated a municipal water system since 1926. The water system is a division of the City Public Works Department with 17 full-time employees under the direction of the Water Superintendent. The City has two sources of domestic water supply--the Solano Project and the City of Vallejo. Future water supplies may come from the planned North Bay Aqueduct. The following diagram (Figure W-1) illustrates the City's water system.

FIGURE W-1 CITY OF FAIRFIELD WATER SYSTEM



The primary source of domestic (non-agricultural) water for the City of Fairfield is the Solano Project of the Federal Bureau of Reclamation. This project provides 247,000 acre feet of water each year to the Solano County Flood Control and Water Conservation District from Lake Berryessa. Although water from the Solano Project is used primarily for irrigation, the City of Fairfield has contracted with the District for 9,200 acre feet of water each year for domestic use. The City's share of Solano Project water is generally increased each year through transfer allocation. As the City annexes certain agricultural lands, water allocated for crop irrigation on those parcels is added to the City's entitlement.

Water is delivered to the City through the Putah South Canal. The water from this canal is treated at the Dickson Hill Treatment Plant. This plant has the capacity to process 10 million gallons per day (MGD).[1] The treated water is then stored for domestic use at the 7 MG Dickson Hill Reservoir. Some of the water from the Dickson Hill Treatment Plant is also stored for emergency use at the 1.8 MG Gluson Reservoir and the 5MG Ray Venning Reservoir.

The City of Fairfield also receives water from the Solano Project through another source. A portion of the water from the Solano Project is allocated to the Solano Irrigation District. In 1974,

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[1] An acre foot of water, enough to cover an acre to a depth of one foot, contains approximately 325,850 gallons. Thus, 1000 acre feet of water per year, if delivered in equal daily amounts, would mean about 892,750 gallons per day or 0.893 MGD.

the City of Fairfield negotiated a contract with the District to annually exchange up to 6,000 acre feet of effluent from Fairfield's new subregional (tertiary) treatment plant for an equal amount of the Districts' allocation of fresh water.

This water is also delivered to the City through the Putah South Canal. The water is treated at the Waterman Treatment Plant which can process 15 MGD. This water is stored for domestic use in the 10 MG Waterman Reservoir. A portion of the Waterman Plant water may also be stored for emergency use in the 1.8 MG Gluson Reservoir and the 5 MG Ray Venning Reservoir.

The secondary source of water for the City of Fairfield is the City of Vallejo. The present agreement, which extends to 1982, with the City of Vallejo provides for the purchase of surplus water by the City of Fairfield. Eventually, however, increasing demands for water in Vallejo will mean discontinuance of this agreement for sale of surplus water to Fairfield.

Water from Vallejo is delivered through Cache Slough to the Venning Treatment Plant. This plant has a treatment capacity of 3 MGD. The treated water is stored at the Venning Reservoir with a capacity of 5 MGD. Because the Vallejo water is generally more expensive to purchase and treat than the water from the Solano Project, this water is used for stand-by reserve. However, Vallejo has also agreed to supply 1 MGD of treated water for use

at mutually acceptable locations within the Cordelia planning area

In the 1980s, the City of Fairfield may begin to tap water supplies from the North Bay Aqueduct. This source can, if requested, deliver up to 4,333 acre feet per year through the Vallejo Cache Slough.

The existing water treatment and reservoir system can deliver approximately 28 million gallons of domestic water daily. Additional treatment and associated storage facilities will be constructed, as needed, in increments of 10 MGD.

The City's water distribution network consists of approximately 113 miles of water line. There are four miles of main water pipes with a diameter of at least 24 inches and 109 miles of 16 inch or smaller diameter water lines. Where necessary, additional water mains will be constructed by the City, usually through contract with local developers. Additional water distribution pipes ($\geq$ 16" diameter) are installed by individual developers.

Water Demand

The first operation of the water subsystem is to compute the demand for domestic water. The logic of all water demand calculations closely parallels those for sewage treatment demand in the sewer subsystem. This demand is measured in millions of gallons per day. The water subsystem computes separately the number of gallons demanded by single and multi-family housing

units as well as the demand from commercial and industrial developments. Special water demands for schools and areas outside the city limits are also computed separately.

As noted earlier, the CRIS Model divides housing units into six categories. The categories are determined by the type of housing unit and the number of bedrooms within each type. The six categories of housing units are shown in Table W-1.

TABLE W-1

Housing Categories

Housing Category	Housing Type	Number of Bedrooms
1	Single Family	2
2	Single Family	3
3	Single Family	4+
4	Multi-Family	0-1
5	Multi-Family	2
6	Multi-Family	3+

The CRIS Model computes the number of newly occupied housing units for both the Fairfield and Cordelia planning areas. These calculations are made in the demographic subsystem. For purposes of calculating the water demand, the number of newly occupied housing units must be aggregated across both planning areas and computed separately for single- and multi-family units. The number of newly occupied single-family housing units ($\Delta HUSF$) is computed in equation W-1 by adding the single-family units from the

Fairfield planning area (ΔHUF) and the single-family units from the Cordelia planning area (ΔHUC).

$$\Delta HUSF_{t+1} = \sum_{k=1}^{3} (\Delta HUF_{k,t+1} + \Delta HUC_{k,t+1}) \tag{W-1}$$

Similarly the number of newly occupied multi-family units ($\Delta HUMF$) is computed as the sum of newly occupied multi-family housing units in each planning area.

$$\Delta HUMF_{t+1} = \sum_{k=4}^{6} (\Delta HUF_{k,t+1} + \Delta HUC_{k,t+1}) \tag{W-2}$$

The total of all occupied single-family housing units (HUSF) is the sum of the newly-occupied units (from equation W-1) and the total number of occupied units from the previous period.

$$HUSF_{t+1} = HUSF_t + \Delta HUSF_{t+1} \tag{W-3}$$

The total of all occupied multi-family housing units (HUMF) is the sum of the newly occupied multi-family units (from equation W-2) and the currently occupied units.

$$HUMF_{t+1} = HUMF_t + \Delta HUMF_{t+1} \tag{W-4}$$

The daily water demand from all single-family housing units (WDSF) is calculated in equation W-5. This calculation is made using a parameter that represents the average daily water demand for each single-family unit (WD/SF).

$$WDSF_{t+1} = HUSF_{t+1} * WD/SF_p \tag{W-5}$$

The daily water demand for multi-family units (WDMF) is calculated in the same manner as for single-family units using the average daily demand per multi-family unit (GD/MF).

$$WDMF_{t+1} = HUMF_{t+1} * WD/MF_{p} \qquad (W-6)$$

The demand for domestic water from commercial developments is estimated on the basis of the number of commercially developed acres. Equation W-7 calculates the increase in water demand for new commercial development (ΔWDC) as the product of the input for newly developed commercial acreage (ΔCA) and the parameter for average water demand per commercial acre (WD/CA).

$$\Delta WDC_{t+1} = \Delta CA_{t+1} * WD/CA_{p} \qquad (W-7)$$

The total water demand for all commercial developments (WDC) is computed as the sum of the water demands from the previous period and the commercial water demands from the current period. This is calculated in equation W-8 below.

$$WDC_{t+1} = WDC_{t} + \Delta WDC_{t+1} \qquad (W-8)$$

As with the demand for industrial sewage treatment, industrial water demand is disaggregated into two categories: light and heavy industry. The water demand from light industry is calculated in the manner similar to the water demand from commercial development. Thus, in equation W-9 the demand for water from

newly developed light industries (ΔWDLI) is calculated by multiplying the newly developed light industrial acreage (ΔLIA) and the parametric water demand per light industrial acre (DW/LIA).

$$\Delta WDLI_{t+1} = \Delta LIA_{t+1} * WD/LIA_{P} \quad \text{(W-9)}$$

Equation W-10 computes the total demand from water treatment from light industrial development (WDLI) as the sum of the demand from light industry in the previous period and the water demand from new light industrial development.

$$WDLI_{t+1} = WDLI_{t} + \Delta WDLI_{t+1} \quad \text{(W-10)}$$

Because heavy industrial development is by its nature episodic such development is not projected in the CRIS model. Therefore, heavy industrial development is taken as input directly from the industrial development schedules (see Appendix A). Calculating the water demand from heavy industrial development is further complicated by the considerable variability in the nature of the industries involved. Therefore, the demand for water from new heavy industrial development (ΔWDHI) is also taken directly from the development schedules. Equation W-11 calculates the total demand for water from heavy industry (WDHI) as the sum of the demand from the previous period and the new demand input.

$$WDHI_{t+1} = WDHI_{t} + \Delta WDHI_{t+1} \quad \text{(W-11)}$$

Fairfield provides water to the schools located within the city's

incorporated area. Schools located outside the city limits receive water from other water agencies. Equation W-12 calculates the total demand for water from the Fairfield schools (WDS) as a function of the school enrollment within the Fairfield and Cordelia planning areas. Water demand is obtained by multiplying the school enrollment in all grade categories by the average daily water demand per student (WD/STUD). In the following equation ENRF is the school enrollment from the Fairfield planning area (from equations E-34 through E-36) and ENRC is the school enrollment from the Cordelia planning area (from equations E-37 through E-39). The "j" subscript indicates the grade category as shown in Table D-3.

$$WDS_{t+1} = \sum_{j=1}^{3} (ENRF_{j,t+1} + ENRC_{j,t+1})) \quad \text{(W-12)}$$

$$* \ WD/STUD_p$$

In a limited number of cases Fairfield provides domestic water to areas outside the city limits. In the CRIS model the water demand from outside areas (WDOA) is treated as a parameter that can be set by the user.

Equation W-13 computes the total water demand (WD) as the sum of the water demand from single-family housing units (WDSF), multi-family housing units (WDMF), commercial acreage (WDC), light industrial acreage (WDLI), heavy industrial development (WDHI), the local schools (WDS), and outside areas (WDOA). This total

is multiplied by a factor which represents the average loss as a result of leaks in the distribution system (WL).

$$WD_{t+1} = (WDSF_{t+1} + WDMF_{t+1} + WDC_{t+1} + WDLI_{t+1} + WDHI_{t+1} + WDS_{t+1} + WDOA_{p}) * (1 + WL_{p}) \tag{W-13}$$

Water Supply

The next operation of the water subsystem is to test the total water demand from equation W-13 against the existing deliverable water supply (WS). Like the water demand the existing supply is measured in millions of gallons per day. To allow sufficient time for construction of additional water treatment plants and reservoirs, the deliverable supply is reduced by the water lead time (WLT) factor. This factor will always have a value less than or equal to one; initially the value is set at .99.

$$WD_{t+1} \leq WS_{t} * WLT_{p} \tag{W-14}$$

If the condition in W-14 is sustained, no additional supply is required to accommodate the demand for water treatment. However, if the condition is violated and the demand exceeds the deliverable water supply, then additional water facilities (ΔWF) must be constructed. Equation W-15 calculates the new water supply by multiplying the number of water facilities constructed by the supply per facility (WS/WF) and adding this to the existing supply.

$$WS_{t+1} = WS_t + \Delta WF_{t+1} * WS/WF_p \qquad (W\text{-}15)$$

At this point the test and equation in W-14 is repeated. If the condition is again violated, additional water supplies are constructed and added to equation W-15.

Water Distribution

The water distribution system consists of the miles of waterlines which underlay the City of Fairfield. These water pipes are disaggregated into three types on the basis of the type of diameter as noted in Table W-2.

TABLE W-2

Water Pipe Categories

Category	Pipe Diameter
1	< 12 inch
2	12 inch
3	> 12 inch

As new areas of the City are developed, additional water pipe (ΔWP) must be installed. The amount of water line for each pipe category is taken as input from the development schedules (see Appendix A). Equation W-16 below calculates the total amount of new water pipe (ΔWPT) as the sum of all newly installed water pipe for the three categories noted above. In the following equation the "n" subscript represents the category of water pipe.

$$\Delta WPT_{t+1} = \sum_{n=1}^{3} \Delta WP_{n,t+1} \qquad (W\text{-}16)$$

The total water pipe in the City's distribution system (WP) is calculated in equation W-17 as the sum of the newly installed water pipe (ΔWPT) and the amount of water pipe from the previous period.

$$WP_{t+1} = WP_t + \Delta WPT_{t+1} \qquad \text{(W-17)}$$

Water Capital Costs

Capital expenditures for the water subsystem include the costs for construction of additional reservoirs, treatment facilities, and installation of additional water pipe. Equation W-18 calculates the capital costs for new water treatment facilities (ΔWFCC) by multiplying the variable representing the need for new water supply facilities (from equation W-15) and the parameter for capital cost of such facilities (CC/WF).

$$\Delta WFCC_{t+1} = \Delta WF_{t+1} * CC/WF_p \qquad \text{(W-18)}$$

It is assumed in the water subsystem that added water treatment facilities will be paid from the sale of municipal bonds. Equation W-19 calculates the total increase in bond payments for new water supply (ΔTPMTW). In this equation the bond interest rate (BIW) is a standard rate established by the user. The payment period is set at 25 years.

$$\Delta TPMTW_{t+1} = \Delta WFCC_{t+1} + (\Delta WFCC_{t+1} * BIW_p) \qquad \text{(W-19)}$$

$$/ (1 - (1 + BIW_p) ** (-25))$$

To obtain an approximation of the annual bond payment, ($\Delta PMTW$) the total bond payment from equation W-19 must be divided by the payment period as in equation W-20.

$$\Delta PMTW_{t+1} = \Delta TPMTW_{t+1} / 25 \tag{W-20}$$

The value obtained from equation W-20 is used in the revision of the water bond principal and interest payment schedule. Annual payments for water bonds (PMTW) are calculated in equation W-21 as the sum of the water bond payments for the current period ($PMTW_t$) and those increases for additional facilities ($\Delta PMTW$).

$$PMTW_{t+1} = PMTW_{t+1} + \Delta PMTW_{t+1} \tag{W-21}$$

In Fairfield, developers are required to install all necessary water pipes. However, the City reimburses developers for the incremental cost of oversizing for water pipes which are more than 12 inches in diameter. Therefore, the capital costs for the installation of water pipes (CCWP) is calculated in equation W-22 as the sum of all newly installed water pipe from category 3 multiplied by the category specific capital costs per foot of water pipe (CC/WP).

$$CCWP_{t+1} = \Delta WP_{3,t+1} * CC/WP_{3,p} \tag{W-22}$$

Finally, the total capital costs for the water subsystem (WCC) are calculated in equation W-23 as the sum of the water bond payments and the water pipe costs.

$$WCC_{t+1} = PMTW_{t+1} + CCWP_{t+1} \quad \text{(W-23)}$$

Operating and Maintenance Costs

The operation and maintenance costs for the water division can be separated into three categories based on the three operations of the division--water treatment and storage, water transport, and administration. In addition, the operating cost for the water division includes the cost of the raw water delivered to the City.

Operation and maintenance costs at the water treatment plants and the water storage reservoirs are a function of the existing water supply.

In the following equation the operating and maintenance costs associated with water storage (WSOMC) are obtained by multiplying the existing water supply (WS) by the average operating and maintenance cost per MGD of capacity (OMC/MGD).

$$WSOMC_{t+1} = WS_{t+1} * OMC/MGD_{p} \quad \text{(W-24)}$$

The maintenance staff required to repair water pipes is a direct function of the amount of water pipes installed. Equation W-25 calculates the water pipe maintenance staff requirement (WPMSR) by multiplying the existing installed water pipe by the staff required to maintain a unit of such pipe.

$$WPMSR_{t+1} = WP_{t} * MSR/WP_{p} \quad \text{(W-25)}$$

The number of new staff hired must, of course, be added in increments of at least one staff person. Equation W-26 determines whether any new staff ($\Delta WPMS$) will be added to the existing water pipe maintenance crews. In this equation the number of new staff required is always rounded down (as denoted by the prime superscript) to ensure that staff is added only in full increments.

$$\Delta WPMS_{t+1} = WPMSR'_{t+1} - WPMS_t \qquad (W-26)$$

Equation W-27 calculates the total water pipe maintenance staff (WPMS) as the sum of the staff existing in the previous period and the newly hired staff (from equation W-26) if any.

$$WPMS_{t+1} = WPMS_t + \Delta WPMS_{t+1} \qquad (W-27)$$

The CRIS Model assumes that additional staff will be added to existing water pipe maintenance crews until such time as a new crew is necessary. At that time, staff which has been added to the existing crews will be reformed to create a new water pipe maintenance crew. The requirements for a new water pipe maintenance crew (WPMTR) is calculated in equation W-28 by factoring the water pipe maintenance staff (from equation W-27) and the average number of maintenance staff in each maintenance crew (MTR/MS). Again, maintenance crews are added only when there are sufficient staff members already hired to complete the maintenance crew requirement as denoted by the prime superscript in the following equation.

$$WPMTR_{t+1} = WPMS_{t+1} * MTR/MS_{p} \tag{W-28}$$

The number of newly created water pipe maintenance crews ($\Delta WPMT$) is calculated in equation W-29 by subtracting the number of maintenance crews existing in the previous period (WPMT) from the water pipe maintenance crew requirement.

$$\Delta WPMT_{t+1} = WPMTR_{t+1} - WPMT_{t+1} \tag{W-29}$$

The total number of water pipe maintenance crews (WPMT) is calcultated in equation W-30 by adding the number of crews existing from the previous period and the number of crews created in the current period.

$$WPMT_{t+1} = WPMT_{t} + \Delta WPMT_{t+1} \tag{W-30}$$

The annual costs for water pipe maintenance can be estimated by calculating those costs associated with the number of water pipe maintenance staff and those costs associated with the number of water pipe maintenance crews. The staff costs include salary and benefits for the personnel as well as the cost of individual equipment for each staff person. The costs associated with the maintenance crew includes those costs for the operation of trucks, backhoes and other crew equipment. In the following equation, WPMC is the water pipe maintenance cost, WPMS is the number of water pipe maintenance staff (from equation W-27), WPMT is the number of water pipe maintenance crews (from equation W-30),

C/MS is the parameter for average cost per staff person, and C/MT is the parameter for the average operating costs of a maintenance crew.

$$WPMC_{t+1} = WPMS_{t+1} * C/MS_{p} + WPMT_{t+1} * C/MT \qquad (W\text{-}31)$$

The cost of new water pipe maintenance crew equipment (WPMEC) is calculated in the equation W-32. These costs are computed by multiplying the number of new water pipe maintenance crews (from equation W-29) by the average costs of the equipment for each maintenance crew (EC/MT).

$$WPMEC_{t+1} = \Delta WPMT_{t+1} * EC/MT_{p} \qquad (W\text{-}32)$$

The administrative costs for the water division (WDAC) can be calculated on the basis of total water demand, fixed costs, or both. In the following equation WD is the total water demand (from equation W-14), AC/WD represents the administrative costs for each unit of water demand, and WFAD is the fixed administrative cost of the water division.

$$WDAC_{t+1} = WD_{t+1} * AC/WD_{p} + WFAD_{p} \qquad (W\text{-}33)$$

The final operating cost for the City's water division is the cost of purchasing the raw water from the Solano Flood Control and Water Conservation District or other sources. This cost is calculated in equation W-34 on the basis of the total water demand (WD). The raw water cost is represented by the mnemonic RWC and

C/WD is the parametric cost per unit of water demand.

$$RWC_{t+1} = WD_{t+1} * C/WD_p \tag{W-34}$$

Equation W-35 calculates the total operating and maintenance costs for the water division (WOMC) as the sum of the operating and maintenance costs for water storage (WSOMC), the maintenance costs for water pipe (WPMC) the costs for crew equipment (WPMEC), the division's administrative costs (WDAC), and the cost of raw water (RWC).

$$WOMC_{t+1} = WSOMC_{t+1} + WPMC_{t+1} + WPMEC_{t+1} + WDAC_{t+1} + RWC_{t+1} \tag{W-35}$$

Water Revenues

The water department of the City of Fairfield has four sources of revenue--connection fees, water service charges, and industrial availability charges which are established by special agreement.

Water connection fees are levied for each new hook-up to the water system. The amount of the fee is based on the size of the meter or pipe which serves the new facility. The meter size is itself based largely on the type of facility constructed. For example, individual dwelling units are usually served by a 3/4 or one inch pipe while a large industrial facility may use one or more four inch pipes. Basically, the connection fees can be estimated on

the basis of the type of development and the number of units constructed.

The following equation calculates the connection charges for new single-family residential development (SFWCC) by multiplying the total number of new single-family dwelling units ($\Delta HUSF$) by the average connection charge per unit (WCCSF).

$$SFWCC_{t+1} = \Delta HUSF_{t+1} * WCCSF_{p} \qquad \text{(W-36)}$$

The connection charges for multi-family dwelling units (MFWCC) is calculated in a similar manner in equation W-37. In the following equation $\Delta HUMF$ represents the number of newly constructed multi-family housing units and WCCMF represents the average connection charge per unit.

$$MFWCC_{t+1} = \Delta HUMF_{t+1} * WCCMF_{p} \qquad \text{(W-37)}$$

The number of commercial and industrial water connections can be taken as an input directly from the development schedules to the CRIS Model. The following equation calculates the commercial and industrial connection charges (CIWCC) by multiplying the number of water hook-ups for commercial and industrial development (ΔCWM and ΔIWM, respectively) by the average charge for each type of connection.

$$CIWCC_{t+1} = (\Delta CWM_{t+1} * CCC_{p}) + (\Delta IWM_{t+1} * ICC_{p}) \qquad \text{(W-38)}$$

The number of new permanent school facilities (PERM) is taken from equations E-51 and E-52 in the education subsystem. The water connection charge for these school facilities (SWCC) is calculated in the following equation where SCC represents the average connection charge per school.

$$SWCC_{t+1} = PERM_j * SCC_p \tag{W-39}$$

The following equation calculates the total connection charges (WCCT) for the City water system as the sum of the charges for single- and multi-family housing units (SFWCC and MFWCC, respectively), commercial and industrial development (CIWCC), school construction (SWCC), and development in areas outside the Fairfield city limits (OAWCC). The connection charges from outside area development is treated as a parameter based upon historic averages.

$$WCCT_{t+1} = SFWCC_{t+1} + MFWCC_{t+1} + CIWCC_{t+1} + SWCC_{t+1} + OAWCC_p \tag{W-40}$$

Water Service Charges

The service charges for water (WSC) use are estimated on the basis of total water demand. These service charges are computed in the following equation by multiplying the total water demand (WD) from equation W-13, by the average annual service charge per unit of water (SC/MGD). In fact the service charge used in this equation is an approximation. The actual charge for any water customer

includes both a fixed and variable charge. The fixed charge is dependent upon the size of the water pipe and meter installed. This allows the customer to use a basic amount of water for a single monthly fee. The variable charge is a fee levied on the amount of water over the basic amount which is used by the customer.

$$WSC_{t+1} = WD_{t+1} * SC/MGD_{p} \tag{W-41}$$

Major industrial users of treated water must pay an industrial stand-by charge for the water service. The water industrial stand-by charge is in addition to other connection and service charges. This charge is usually levied in the form of a schedule of payments over a period of years beginning with the first year of industrial operation.

The CRIS Model maintains a schedule of industrial stand-by payments for water service. Charges associated with a particular industrial development are taken as input directly from the development schedules. These inputs are used to revise the industrial stand-by payment schedules. Equation W-42 calculates the revenues from the water industrial stand-by charges (WISBC) as the sum of the scheduled payments (WISBC) for the current period and the charges for new construction during the period (ΔWISBC).

$$WISBC_{t+1} = WISBC_{t} + \Delta WISBC_{t+1} \tag{W-42}$$

As noted earlier, the City of Fairfield compensates developers for the cost of installing any water pipe of greater than 12 inch diameter. The City is indemnified for this oversizing cost as other developments occur along and are connected to the over-sized pipe. The subsequent developers must pay a special over-sizing fee. The revenues from the water oversizing fee (WOZR) for each development are taken directly from the residential, commercial, and industrial development schedules (RWOZ, CWOZ, and IWOZ, respectively). The revenue from this fee is maintained in a separate account.

$$WOZR_{t+1} = RWOZ_{t+1} + CWOZ_{t+1} + IWOZ_{t+1} \qquad \text{(W-43)}$$

The following equation calculates the total revenue for the water department (WDR). This is computed as the sum of the total water connection charges (WCCT), the water service charges (WSC), and the water industrial availability charges (WISBC).

$$WDR_{t+1} = WCCT_{t+1} + WSC_{t+1} + WISBC_{t+1} \qquad \text{(W-44)}$$

STREET AND ROAD SUBSYSTEM

The Streets Division of the Fairfield Public Works Department conducts three activities--street maintenance, street repair, and street sweeping.

Much of the work done by the street maintenance activity is the ordinary repair of road surface failures. However, street maintenance crews also install street signs and signals, stripe street lanes, and maintain ditches and municipal parking lots. Where necessary, they also make repairs to sidewalks, curbs and gutters.

The street repair activity has the responsibility for covering the cuts made for water and sewer work. This activity also repairs streets that are opened as a result of work done by private utility companies. Work done to repair cuts created by city departments is done without charge. Work done to repair privately created damage is billed to the relevant party.

In addition to the above "as they occur" activities, the Streets Division has a regular program of street sweeping. Generally, residential areas are swept once every three weeks. Commercial areas of the city are swept twice a week and the downtown portion of Fairfield is swept once a day. Presently, the City of Fairfield has three street sweepers.

Fairfield Street System

The first operation of the streets and roads subsystem is to compute the amount of streets in the City. For this purpose, the City streets are divided into four categories on the basis of the type of development which is served by those streets--residential streets, streets in commercial areas, streets serving industrial developments and other, non-classified streets.

In the CRIS Model, the amount of streets is expressed in lane miles. The model considers four types of streets - one-lane alleys, two-lane local streets (including frontage roads), three-lane collector streets (including those with left-turn collector lanes) and four-lane arterials.

Streets, of any type, constructed to serve newly developed areas are often "oversized" at the request of the City. The developer must, of course, install at least the one-lane half of a street to serve local development. When the development is on each side of a street, the developer is responsible for construction of at least a basic two-lane street. However, the City may request, at the time the development is approved, that the contractor add a third or fourth lane to some local streets, thus extending the City's pattern of collector and arterial roadways. In the case of a four-lane street, for example, the developer

is responsible for the two outside lanes including the curbs and gutters; the City of Fairfield compensates the developer for the cost of the two inside lanes and the median strip.

Sometimes the City will widen streets several years after development has occurred. In this case, the City bears the entire cost of the street widening. The City performs small street widening jobs with crews from the street division and contracts for large street widening jobs.

The number of lane miles of residential streets in the Fairfield planning area (LMRF) is computed in equation SR-1. The number of newly constructed lane feet of residential streets (LFRF) is added to the lineal footage of residential streets over-sizing (RSOSF) and the lineal footage of residential street widening (RSWF) within the Fairfield planning area. This lane footage is added across the four types of streets. Because street data is most easily obtainable in feet, the equation must convert footage to lane miles of residential streets in the Fairfield planning area. This sum is then added to the number of lane miles of residential streets from the previous period.

$$LMRF_{t+1} = LMRF_t + ((\sum_{q=1}^{4}(\Delta LFRF_{q,t+1}) + RSOSF_{q,t+1} + RSWF_{q,t+1}) * 1/5280 \qquad \text{(SR-1)}$$

Equation SR-2 computes the number of lane miles of commercial streets in the Fairfield planning area (LMCF). The equation is comparable to that for residential streets: LFCF is the number of newly constructed lane feet of commercial streets. CSOSF is the amount of commercial street oversizing and CSWF is the footage of commercial street widening.

$$LMCF_{t+1} = LMCF_t + ((\sum_{q=1}^{4} (\Delta LFCF_{q,t+1}) + CSOSF_{q,t+1} + CSWF_{q,t+1}) * 1/5280 \quad \text{(SR-2)}$$

The lane miles of industrial streets in the Fairfield planning area (LMIF) is computed in the same way in equation SR-3.

$$LMIF_{t+1} = LMIF_t + ((\sum_{q=1}^{4}(\Delta LFIF_{q,t+1}) + ISOSF_{q,t+1} + ISWF_{q,t+1}) * 1/5280 \quad \text{(SR-3)}$$

The total lane miles of streets in the Fairfield planning area (LMTF) is computed in equation SR-4 by addiing the lane miles of residential streets (LMRF), the lane miles of commercial streets (LMCF) and the lane miles of industrial streets (LMIF). The total lane miles of streets in Fairfield includes not only those streets which were built as a result of residential, commercial or industrial development, but some streets from the previous period which could not be classified as strictly serving one type of development (e.g., frontage roads). The lane miles of such non-classified streets is represented by the mnemonic LMNCF.

$$LMTF_{t+1} = LMRF_{t+1} + LMCF_{t+1} + LMIF_{t+1} \; LMNCF_p \quad \text{(SR-4)}$$

Cordelia Street System

The subsystem calculates the lane miles of streets in the Cordelia planning area in the same manner as for the Fairfield planning area. Equation SR-5 computes the lane miles of residential streets in the Cordelia planning area (LMRC) where ΔLFRC is the number of newly constructed lane feet of residential streets in the Cordelia planning area. This footage is added to the footage of residential street oversizing (RSOSC) and the footage of residential street widening (RSWC) within the Cordelia planning area. The lane footage is added across all types of streets and divided to yield the total number of newly constructed lane miles. As with the Fairfield planning area, this sum of newly constructed streets is then added to the lane miles of residential streets from the previous period.

$$LMRC_{t+1} = LMRC_t + ((\sum_{q=1}^{4} (\Delta LFRC_{q,t+1}) + RSOSC_{q,t+1} + RSWC_{q,t+1}) * 1/5280 \qquad (SR-5)$$

Equation SR-6 calculates the lane mileage of commercial streets in the Cordelia planning area (LMCC). In this equation ΔLFCC is the newly constructed lane feet of commercial streets, CSOSC is the commercial street oversizing, and CSWC represents commercial street widening.

$$LMCC_{t+1} = LMCC_t + ((\sum_{q=1}^{4} (\Delta LFCC_{q,t+1}) + CSOSC_{q,t+1} + SCWC_{q,t+1}) * 1/5280 \qquad (SR-6)$$

The number of lane miles of industrial streets in the Cordelia planning area (LMIC) is computed in equation SR-7 where $\Delta LFIC$ is the newly constructed lane feet of industrial street, ISOSC is the amount of industrial street oversizing, and ISWF represents the footage of industrial street widening.

$$LMIC_{t+1} = LMIC_t + ((\sum_{q=1}^{4} (\Delta LFIC_{q,t+1}) + ISOSC_{q,t+1} + ISWC_{q,t+1}) * 1/5280 \qquad \text{(SR-7)}$$

Equation SR-8 computes the total lane miles of streets in the Cordelia planning area (LMTC). In the following equation, LMRC is the lane miles of residential streets, LMCC represents the lane miles of commercial streets, and LMIF is the lane miles of industrial streets. The total lane miles of streets in the Cordelia planning area includes streets from the previous period which could not be classified as serving one particular type of development. The lane miles of these non-classified streets are represented by LMNCC.

$$LMTC_{t+1} = LMRC_{t+1} + LMCC_{t+1} + LMIC_{t+1} + LMNCC_p \qquad \text{(SR-8)}$$

The total lane miles of streets (LMT) is calculated in equation SR-9 as the sum of the lane miles in the Fairfield planning area (LMTF) and the lane miles in the Cordelia planning area (LMTC).

$$LMT_{t+1} = LMTF_{t+1} + LMTC_{t+1} \qquad \text{(SR-9)}$$

Capital costs of Street Construction

Generally, individual developers are required to install all streets at the time adjoining property is developed. However, the City of Fairfield must compensate developers or contractors for oversizing or widening arterial or larger streets. This compensation represents part of the capital cost of a portion of the arterial street construction borne by the City of Fairfield. The remainder of the local capital cost is for street widening.

Equation SR-10 calculates the lane miles of street oversizing in the Fairfield planning area (LMOSF). This is computed by summing the lane footage of street oversizing for residential development (RSOSF), commercial development (CSOSF), and industrial development (ISOSF).

$$LMOSF_{t+1} = \sum_{q=1}^{4} (RSOSF_{q,t+1} + CSOSF_{q,t+1} + ISOSF_{q,t+1}) \quad \text{(SR-10)}$$
$$* \; 1/5280$$

Similarly, equation SR-11 calculates the lane miles of street oversizing for the Cordelia planning area (LMOSC) where RSOSC is the footage of street oversizing for residential developments, RSOSC is the oversizing for commercial developments and ISOSC is industrial street oversizing.

$$LMOSC_{t+1} = \sum_{q=1}^{4} (RSOSC_{q,t+1} + CSOSC_{q,t+1} + ISOSC_{q,t+1}) \quad \text{(SR-11)}$$
$$* \; 1/5280$$

Equation SR-12 calculates the total lane miles of street oversizing (LMOS).

$$LMOS_{t+1} = LMOSF_{t+1} + LMOSC_{t+1} \qquad \text{(SR-12)}$$

The lane miles of street widening in the Fairfield planning area (LMSWF) is the sum of the street widening for residential development (RSWF), commercial development (CSWF) and industrial development (ISWF). As with other equations, the footage of widened streets are added across all types of streets and converted to lane miles. This computation is made in equation SR-13 below.

$$LMSWF_{t+1} = \sum_{q-1}^{4} (RSWF_{q,t+1} + CSWF_{q,t+1} + ISWF_{q,t+1}) * 1/5280 \qquad \text{(SR-13)}$$

Equation SR-14 makes the same calculations for the lane miles of street widening in the Cordelia planning area (LMSWC).

$$LMSWC_{t+1} = \sum_{q=1}^{4} (RSWC_{q,t+1} + CSWC_{q,t+1} + ISWC_{q,t+1}) * 1/5280 \qquad \text{(SR-14)}$$

The total lane miles of street widening is computed in equation SR-15 where LMSWF is the lane miles of widening streets in the

Fairfield planning area and LMSWC is street widening in the Cordelia planning area.

$$LMSW_{t+1} = LMSWF_{t+1} + LMSWC_{t+1} \qquad \text{(SR-15)}$$

As noted earlier, the City of Fairfield compensates local developers for that portion of the local serving street which is oversized. Equation SR-16 calculates the capital cost of the street oversizing (CCOS) by multiplying the lane miles of oversized streets (from equation SR-12) by the average of lane mile cost of street oversizing (CC/LMOS).

$$CCOS_{t+1} = LMOS_{t+1} * CC/LMOS_p \qquad \text{(SR-16)}$$

Equation SR-17 calculates the capital cost for street widening (CCSW). This cost is computed by multiplying the average cost per lane mile of widened street (CC/LMSW) by the total miles of street widening (LMSW) from equation SR-15.

$$CCSW_{t+1} = LMSW_{t+1} * CC/LMSW_p \qquad \text{(SR-17)}$$

Maintenance Activity

The basic responsibility of the maintenance activity is to maintain the road surface. Secondary responsibilities of this activity include maintenance of parking lots, street signs, signals, and ditches. The City emphasizes preventive maintenance.

Such a program requires more planning, but in the long run it is easier, cheaper, faster and requires less manpower waiting for major street repairs.

Equation SR-18 calculates the street maintenance crew requirements (SMCR). It is the policy of the streets division to add maintenance crew staff only when there is a need for at least one additional maintenance person. This is noted in the equation by the prime superscript which rounds down the maintenance crew requirement to the next lowest whole increment. The maintenance crew requirement is calculated by multiplying the total lane miles of streets (LMT), from equation SR-9, by the parameter representing staff requirements per lane mile (SMC/LM). Since it can be assumed that newly constructed streets will not require maintenance, the lane mileage from the previous period is used in the calculation.

$$SMCR'_{t+1} = LMT_t * SMC/LM_p \qquad \text{(SR-1}$$

The number of newly hired street maintenance crew personnel, if any, is represented by the mnemonic ΔSMC. This is computed in equation SR-19 by subtracting the number of personnel on the existing street maintenance crew (SMC) from the newly computed street maintenance crew requirement (SMCR′).

$$\Delta SMC_{t+1} = SMCR'_{t+1} - SMC_t \qquad \text{(SR-1}$$

Equation SR-20 calculates the total number of personnel on the street maintenance crew (SMC) by adding the number of newly hired staff (ΔSMC) to the number of personnel from the previous period.

$$SMC_{t+1} = SMC_t + \Delta SMC_{t+1} \qquad \text{(SR-20)}$$

The capital cost for the street maintenance crew (SMCC) includes the cost of equipment for newly hired staff (ΔSMC) and the cost of replacement equipment for existing personnel (SMC). This is computed in equation SR-21 where CC/ΔSMC represents the cost of new equipment and CC/SMC represents the cost for replacement equipment.

$$SMCC_{t+1} = (\Delta SMC_{t+1} * CC/\Delta SMC_p) + (SMC_t * CC/SMC_p) \qquad \text{(SR-21)}$$

The street maintenance operating cost (SMOC) includes the cost of salaries for personnel and the maintenance and operating cost for the crew equipment. This is calculated in equation SR-22 on the basis of the total number of street maintenance crew personnel (SMC) and the average operating cost for each crew member (OC/SMC).

$$SMOC_{t+1} = SMC_{t+1} * OC/SMC_p \qquad \text{(SR-22)}$$

Repair Activity

The basic responsibility of the street repair subdivision is to patch the cuts in road surfaces made for installation of underground utilities. The street repair crew requirement (SRCR) is calculated in equation SR-23 by multiplying the total lane

miles of streets (LMT) by the average repair crew requirement per lane mile (SRC/LM). The street division adds new staff only when it is absolutely necessary. The policy of only-as-necessary hiring is accounted for by always rounding the crew requirement to the next lowest whole increment as noted by the prime superscript to the mnemonic. Again, the lane mileage from the previous period is used because it is assumed that all underground installations were made before street construction in the current period.

$$SRCR'_{t+1} = LMT_t * SRC/LM_p \qquad \text{(SR-23)}$$

The number of newly hired street repair crew personnel (ΔSRC) is calculated in equation SR-24 by subtracting the number of street personnel from the previous period (SRC) from the newly calculated street repair crew requirement (SRCR′).

$$\Delta SRC_{t+1} = SRCR'_{t+1} - SRC_t \qquad \text{(SR-24)}$$

The total number of personnel in the street repair crew (SRC) is calculated in equation SR-25 by adding the number of newly hired personnel, if any, to the number of personnel from the previous period.

$$SRC_{t+1} = SRC_t + \Delta SRC_{t+1} \qquad \text{(SR-25)}$$

As with the street maintenance crews, the capital cost for the street repair crews (SRCC) is a function of both new equipment and replacement equipment. The cost of equipment for the newly hired personnel is computed in the following equation by multiplying the number of personnel (ΔSRC) by the average capital cost for each new crew member (CC/ΔSRC). The cost of replacement equipment is computed by multiplying the number of existing repair crew personnel by the average cost for replacement equipment (CC/SRC).

$$SRCC_{t+1} = (\Delta SRC_{t+1} * CC/\Delta SRC_p) + (SRC_t * CC/SRC_p) \qquad \text{(SR-26)}$$

The operating cost for the street repair activity (SROC) is a function of the total lane miles of streets. This is calculated in equation SR-27 by multiplying the number of lane miles (LMT) by the average operating cost per lane mile (OC/LMT).

$$SROC_{t+1} = LMT_t * OC/LMT_p \qquad \text{(SR-27)}$$

Some of the work of the street repair subdivision goes for the repair of street cuts made by private utility companies. The remainder of the street repairs is for street cuts made by other city departments. Equation SR-28 calculates the number of street cuts or the demand for street repairs (SRD) by multiplying the average street repair demand per lane mile (SRD/LM) by the total number of lane miles (LMT).

$$SRD_{t+1} = LMT_t * SRD/LM_p \qquad \text{(SR-28)}$$

Street Sweeping

The cost of street sweeping is a function of the number of lane miles of streets swept (LMSW). This is calculated in equation SR-29 by multiplying the lane miles of streets in each category and planning area by the category specific parameter for street sweeping frequency. In the following equation, RSWF is a parameter for annual street sweeping frequency for residential streets, CSWF represents commercial street sweeping frequency, ISWF represents annual industrial street sweeping frequency and NCSWF represents the annual street sweeping frequency for non-classified streets.

$$\begin{aligned} LMSW_{t+1} = {} & ((LMRF_{t+1} + LMRC_{t+1}) * RSWF_p) + \\ & ((LMCF_{t+1} + LMCC_{t+1}) * CSWF_p) + \\ & ((LMIF_{t+1} + LMIC_{t+1}) * ISWF_p) + \\ & ((LMNCF_{t+1} + LMNCC_{t+1}) * NCSWF_p \end{aligned} \qquad \text{(SR-29)}$$

The requirement for street sweepers (SSWR) is calculated in equation SR-30 by multiplying the annual lane miles of streets swept (LMSW) by the average number of street sweepers per lane mile (SSW/LM). Again the policy of purchasing new street sweepers only when they are absolutely necessary is reflected by rounding the number of street sweepers required downward to the next whole increment.

$$SSWR'_{t+1} = LMSW_{t+1} * SSW/LM_p \qquad \text{(SR-30)}$$

The number of new street sweepers that must be purchased, if any, is represented by the mnemonic ΔSSW. This is calculated in equation SR-31 by subtracting the number of existing street sweepers (SFW) from the street sweeper requirement calculated in equation SR-30.

$$\Delta SSW_{t+1} = SSWR'_{t+1} - SSW_{t} \qquad (SR-31)$$

The total number of street sweepers (SSW) is computed in equation SR-32 by adding the number of new street sweepers (ΔSSW) to the number of street sweepers from the previous period.

$$SSW_{t+1} = SSW_{t} + \Delta SSW_{t+1} \qquad (SR-32)$$

It has been the experience of the City of Fairfield that street sweepers and related equipment last approximately 8 years. Equation SR-33 computes the average amount of equipment that must be replaced each year (SWER) by multiplying the number of street sweepers from equation SR-32 by a parameter representing street sweeper equipment life (SWEL).

$$SWER_{t+1} = SSW_{t+1} * 1/SWEL_{p} \qquad (SR-33)$$

The capital cost for street sweeping equipment (SSWCC) is calculated in equation SR-34 by adding the number of new street sweepers (ΔSW) and the amount of street sweeper equip-

ment replacement (SWER) and multiplying this sum by the average capital cost per street sweeper (CC/SSW).

$$SSWCC_{t+1} = (\Delta SSW_{t+1} + SWER_{t+1}) * CC/SSW_p \qquad \text{(SR-34)}$$

Equation SR-35 calculates the operating cost of the street sweeping activity (SSWOC) as the product of the number of street sweepers (SSW) and the average operating cost per sweeper (OC/SSW). The average operating cost accounts for both labor and maintenance materials.

$$SSWOC_{t+1} = SSW_{t+1} * OC/SSW_p \qquad \text{(SR-35)}$$

Total Cost

The capital cost for the street and roads subsystem includes the cost of street construction and the cost of street repair maintenance and sweeping equipment purchases. Equation SR-36 calculates total capital cost (SCC) where CCOS is the street oversizing cost (from equation SR-16); CCSW is the street widening cost (from equation SR-17); SMCC is the street maintenance equipment cost (from equation SR-21); SRCC is the street repair equipment cost (from equation SR-26); and SSWCC is the street sweeping equipment cost (from equation SR-34).

$$SSC_{t+1} = CCOS_{t+1} + CCSW_{t+1} + SMCC_{t+1} + SRCC_{t+1} + SSWCC_{t+1} \qquad \text{(SR-36)}$$

The operating and maintenance costs for the street division (SOMC) are calculated in the following equation by adding the operating cost for the street maintenance division (SMOC) from equation SR-22, the operating cost of the street repair subdivision (SROC) from equation SR-27 and the street sweeping subdivision (SSWOC) from equation SR-35.

$$SOMC_{t+1} = SMOC_{t+1} + SROC_{t+1} + SSWOC_{t+1} \qquad \text{(SR-37)}$$

The total cost of the street division (STC) is calculated in equation SR-38 by adding the capital cost (SCC) and the operating and maintenance cost (SOMC).

$$STC_{t+1} = SSC_{t+1} + SOMC_{t+1} \qquad \text{(SR-38)}$$

<u>Street and Road Revenue</u>

The Fairfield Streets Division receives two kinds of revenues. The first is from a fee paid by developers for the use of public streets which have been oversized by previous developments. The second source of revenue is the payments made by public and private utility companies or districts for street openings to install or service underground utilities.

As noted earlier, the City pays developers for oversizing streets at the time of initial development. Later, as other developments are constructed along this oversized section, the City collects an oversizing fee. The following set of equations calculates the street oversizing fees for Fairfield

(SOSF) and Cordelia (SOSC) as the sum of the fees paid on residential, commercial, and industrial development in each planning area. The information on the amount of these fees is taken from the residential, commercial, and industrial development schedules.

$$SOSF_{t+1} = SOSFR_{t+1} + SOSFC_{t+1} + SOSFI_{t+1} \qquad \text{(SR-39)}$$

$$SOSC_{t+1} + SOSCR_{t+1} + SOSCC_{t+1} + SOSCI_{t+1} \qquad \text{(SR-40)}$$

The following equation calculates the total oversizing revenue for the Fairfield Street Division (SOST).

$$SOST_{t+1} = SOSF_{t+1} + SOSC_{t+1} \qquad \text{(SR-41)}$$

The Street Division is responsible for opening, closing and resurfacing city streets. When the installation or maintenance of underground utilities necessitates the opening of a street, the utility must compensate the City for the work performed by the street crews. The charges for the street repair work are computed on the basis of the number of square feet of streets repaired (SFSR). This is calcualted in equation SR-42 by multiplying the demand for street repairs (SRD) by the average number of square feet in each repair job (SF/SRD).

$$SFSR_{t+1} = SRD_{t+1} * SF/SRD_{p} \qquad \text{(SR-42)}$$

The revenue from street repairs (SRR) is calculated in equation SR-43. In this equation, the number of square feet of streets repaired is factored by a parameter representing the streets repaired as a result of street cuts made by other public works divisions (PWSR) to yield the number of street cuts from private utility companies. These privately created street cuts are then multiplied by the revenue per square foot (SRR/SF) to yield total street repair revenue.

$$SRR_{t+1} = (SFSR_{t+1} * (1-PWSR_p)) * SRR/SF_p \qquad (SR-43)$$

The total revenue of the Street Division (SDTR) is the sum of the fees from street oversizing (SOST) and street repairs (SRR).

$$SDTR_{t+1} = SOST_{t+1} + SRR_{t+1} \qquad (SR-44)$$

PARKS AND RECREATION SUBSYSTEM

In Fairfield the parks and recreation function is actually performed by two separate agencies within the City. The Parks Division of the Public Works Department maintains the park facilities with exception of community swimming pools. The Parks Division also maintains the landscaping in parking lots and around public buildings. The Recreation Department has responsibility for the operation and maintenance of swimming pools, community center and neighborhood park buildings and park acquisition and development of all city parks. In addition, the Recreation Department staffs various recreation programs in the community.

Park Acquisition

A basic operation of the Parks and Recreation Subsystem is to determine the need for new park facilities. There are three types of park facilities in the City of Fairfield--neighborhood parks which serve a radius of approximately a half a mile; community parks which are frequently located contiguous to an intermediate or high school and serve a radius of up to two miles; and city-wide or special purpose parks which provide major and special use recreation facilities and are designed to serve the entire city.

Neighborhood Parks

The need for additional neighborhood park facilities (ΔNP) has been determined to be a function of the population of the City of Fairfield. Equation PR-1 calculates the requirement for neighborhood parks by multiplying the total Fairfield population (TOTFN) by the ratio of neighborhood park acreage to population (NPA/POP). The requirement for additional park acreage is determined by subtracting the neighborhood park acreage from the previous period (NPA) and factoring this difference by the reciprocal of the minimum park size. In the case of neighborhood parks, the minimum size of the park in relation to efficient design is five acres.

Typically, the City of Fairfield does not construct new neighborhood parks in anticipation of population growth, but rather these facilities are developed to serve an established population. Therefore, neighborhood parks are not constructed until the need for such facilities exceeds the minimum acreage requirement. This is accomplished in equation PR-1 by rounding down to the next lowest whole increment as denoted by the prime superscript.

$$\Delta NP'_{t+1} = ((TOTFN_{t+1} * NPA/POP_p) - NPA_t) * 1/5 \qquad \text{(PR-1)}$$

Equation PR-2 calculates the total acreage of neighborhood parks in the City of Fairfield (NPA). This is determined by multi-

plying the need for additional neighborhood parks (ΔNP) by the average acreage per neighborhood park (A/NP) and adding this product to the existing neighborhood park acreage.

$$NPA_{t+1} = NPA_t = (\Delta NP'_{t+1} * A/NP_P) \qquad \text{(PR-2)}$$

Community Parks

The requirement for community parks has also been established to be a function of the City's population. The need for new community parks (ΔCMP) is calculated in equation PR-3. This need is determined by multiplying the ratio of community park acreage to population (CMPA/POP) by the total Fairfield population (TOTFN). In determining the requirement for additional community park acreage, the community park acreage from the previous period (CMPA) is subtracted from the product. This difference represents the new community park acreage required. However, the City of Fairfield develops new community parks only when the acreage requirement exceeds the minimum efficient design size of 20 acres.

$$\Delta CMP'_{t+1} = ((TOTFN_{t+1} * CMPA/POP_P) - CMPA_t) * 1/20 \qquad \text{(PR-3)}$$

Equation PR-4 calculates the total community park acreage for the City (CMPA). This is computed by multiplying the requirement for new community parks (ΔCMP) by the parametric average acreage

for each community park (A/CMP). This product is then added to the existing community park acreage (CMPA) yielding the acreage for the current period.

$$CMPA_{t+1} = CMPA_t + (\Delta CMP'_{t+1} * A/CMP_P) \qquad \text{(PR-4)}$$

<u>Swimming Pools</u>

The need for additional swimming pools (ΔSWMP) has been established to be a function of the total city population (TOTFN). Equation PR-5 calculates this need by multiplying the current population by the parametric average number of swimming pools per population (SP/POP) and subtracting the number of existing swimming pools (SWMP).

$$\Delta SWMP'_{t+1} = (TOTFN_{t+1} * SP/POP_P) - SWMP_t \qquad \text{(PR-5)}$$

The total number of swimming pools in the current period (SWMP) is calculated in equation PR-6. Here, the requirement for additional swimming pools (ΔSWMP) is added to the number of pools from the previous period.

$$SWMP_{t+1} = SWMP_t + \Delta SWMP'_{t+1} \qquad \text{(PR-6)}$$

<u>City Wide and Special Purpose Parks</u>

City wide parks are designed to serve the entire City. Generally,

the Recreation Department plans to provide approximately 2.5 acres of city parks for each 1,000 residents. However, the minimum efficient size for a city wide park is 250 acres. The need for additional city parks (ΔCTP) is calculated in the equation PR-7 by multiplying the current Fairfield population (TOTFN) by the average city park acreage per population (CTPA/POP) and subtracting the city park acreage from the previous period (CTPA). This acreage requirement is then multiplied by the reciprocal of the minimum efficient design acreage to yield the new city park requirement. Again, the City of Fairfield does not develop a city park until the new acreage requirement exceeds the minimum efficient design as denoted by the prime superscript to the mnemonic.

$$\Delta CTP'_{t+1} = ((TOTFN_{t+1} * CTPA/POP_P) - CTPA_t) * 1/250 \qquad \text{(PR-7)}$$

Total city wide park acreage (CTPA) is calculated in equation PR-8. This is computed by adding the existing park acreage to the product of the additional city park requirement (ΔCTP) and the average size per city park (A/CTP).

$$CTPA_{t+1} = CTPA_t + (\Delta CTP'_{t+1} * A/CTP_P) \qquad \text{(PR-8)}$$

The City also maintains pedestrian and cycling paths throughout the City. These are citywide pathways, using public easements,

rights-of-way and natural features such as watercourses, to provide a non-vehicular circulation system connecting major facilities and points of activity. Often, these pedestrian and cycling paths also provide local amenities such as benches and open space for the neighborhoods in which they exist.

Pedestrian and cycling paths are constructed by developers and deeded to the City for maintenance by the City staff. Therefore, the amount of paths constructed is unique to each development. Equation PR-9 calculates the amount of new pedestrian and cycle paths, measured in feet, ($\Delta PCPF$) as the sum of the path footage constructed with residential, commercial, and industrial developments. This information is taken directly from the schedules for each type of development.

$$\Delta PCPF_{t+1} = PCPFR_{t+1} + PCPFC_{t+1} + PCPFI_{t+1} \qquad \text{(PR-9)}$$

Equation PR-10 calculates the total pedestrian and cycle path footage in the City (PCPF) by adding the existing path footage and the additional pedestrian and cycle path footage from equation PR-9.

$$PCPF_{t+1} = PCPF_{t} + \Delta PCPF_{t+1} \qquad \text{(PR-10)}$$

The City also constructs special recreation facilities. These

special facilities include community centers, sports centers and community theaters. Again, it is assumed that the requirement for additional special facilities (ΔSF) is a function of the total population although this assumption may be altered by user intervention. The need for new special facilities is calculated by subtracting the number of special facilities from the previous period (SF) from the product of the population (TOTFN) and the parameter representing the average number of special facilities per unit of population (SF/POP).

$$\Delta SF'_{t+1} = (TOTFN_{t+1} * SF/POP_{P}) - SF_{t} \qquad \text{(PR-11)}$$

The total number of special facilities (SF) is calculated in equation PR-12 by adding the requirement for additional special facilities (ΔSF) to the number of special facilities from the previous period.

$$SF_{t+1} = SF_{t} + \Delta SF'_{t+1} \qquad \text{(PR-12)}$$

Capital Costs

Specialized recreation facilities such as swimming pools, community centers, or pathways are fully developed at the time of initial construction. However, most parks in the City of Fairfield are developed in phases over a period of years. For example, within the first year after a new neighborhood park is

needed, the City will undertake to purchase the land and provide the basic park design. Within three years after the park site acquisition the overall park development, site clearing and improvements, installation of outdoor play equipment, and the basic landscaping of the park are completed. This is considered to be the initial capital development necessary for each new neighborhood park. It does not constitute full park development. In five years after the initial park development, additional capital investments will be made to complete the improvements to the park.

The capital costs for neighborhood parks (NTCC) is calculated in equation PR-13. Capital costs for new neighborhood parks is computed by multiplying the neighborhood park requirement (ΔNP) by the average cost per neighboorhood park (CC/NP) and adding this product to the annual investment costs for existing neighborhood parks. This investment cost is calculated by multiplying the total acres of neighborhood parks (NPA) by the average investment cost per neighborhood park per acre (IC/NPA) for the eight years of continued park development.

$$NPCC_{t+1} = (\Delta NP'_{t+1} * CC/NP_{P}) + \left(\sum_{s=1}^{8} NPA_{t+1-s} * IC/NPA_{P} \right) \qquad \text{(PR-13)}$$

Similarly, community park capital costs (CMPCC) are calculated in equation PR-14 by adding the capital costs for new community parks and the annual community park investment costs. In the following equation (ΔCNP) represents the additional community park requirement (from equation PR-3) and CC/CMP is the average capital cost for development of new community parks. Also in the following equation, CMPA represents the total acreage of community parks (from equation PR-4) and IC/CMPA represents the annual investment costs for development of community park acreage.

$$CMPCC_{t+1} = (\Delta CMP'_{t+1} * CC/CMP_{P}) + (\sum_{s=1}^{8} CMPA_{t+1-s} * IC/CMPA_{P}) \qquad \text{(PR-14)}$$

Equation PR-15 computes the capital costs for city wide parks (CTPCC). This is computed by adding the capital costs for new city wide parks and the annual investment cost for improvement of these parks. Capital costs are computed by multiplying the average cost for initial city wide park development (CC/CTP) by the additional city wide park requirement (ΔCTP). The annual city wide park improvement costs are computed by multiplying the investment costs per city wide park acre (IC/CTPA) and the total number of city wide park acres (CTPA).

$$CTPCC_{t+1} = (\Delta CTP'_{t+1} * CC/CTP_{P}) + (\sum_{s=1}^{8} CTPA_{t+1-s} * IC/CTPA_{P}) \qquad \text{(PR-15)}$$

Pedestrian and cycling paths are completely constructed by local developers. Therefore, the costs are paid by these developers and not the City.

Capital costs for swimming pools (SPCC) are calculated in equation PR-16. The costs are computed by multiplying the number of new swimming pools required (ΔSWMP) by the average cost per pool (CC/SP). Here it is assumed that the pools are constructed completely in the first year of development.

$$SPCC_{t+1} = \Delta SWMP'_{t+1} * CC/SP_p \qquad (PR-16)$$

The construction costs for special facilities (SFCC) are calculated in equation PR-17. In this equation the number of additional special facilities required is represented by the mnemonic ΔSF and the capital cost of each special facility is represented by the parameter CC/SF.

$$SFCC_{t+1} = \Delta SF'_{t+1} * CC/SF_p \qquad (PR-17)$$

The total capital cost for parks and recreation facilities (PRCC) is simply computed as the sum of the costs for all facilities. In the following equation NPCC, CMPCC, and CTPCC represent the initial capital cost and the annual investment cost for neighborhood, community, and city wide parks, respectively. The capital costs for swimming pools and other special facilities

are represented by the mnemonics SPCC and SFCC, respectively.

$$PRCC_{t+1} = NPCC_{t+1} + CMPCC_{t+1} + CTPCC_{t+1} + SPCC_{t+1} + SFCC_{t+1} \quad \text{(PR-18)}$$

Maintenance Costs

As noted earlier, the Parks Division of the Public Works Department maintains all park and recreation facilities in the City, with the exception of swimming pools. The responsibilities for this division include the maintenance of landscaping around public buildings, water storage reservoirs and water and sewage treatment plants. In addition, the Parks Division is responsible for maintaining the landscaping in public parking lots and the median islands of public roads, as well as the planting and maintenance of all street trees.

The maintenance costs for neighborhood parks (NPMC) is assumed to be a function of the total acres of neighborhood parks (NPA). This is computed in equation PR-19 by multiplying the parametric average maintenance cost per neighborhood park acre (MC/NPA) by the neighborhood park acreage variable.

$$NPMC_{t+1} = NPA_{t+1} * MC/NPA_{p} \quad \text{(PR-19)}$$

Community park maintenance costs (CMPMC) are calculated in equation PR-20 where CMPA represents the total community park acreage and MC/CMPA is the parameter representing the average maintenance cost per community park acre.

$$CMPMC_{t+1} = CMPA_{t+1} * MC/CMPA_{p} \tag{PR-20}$$

Equation PR-21 calculates the city wide park maintenance costs (CTPMC). This is computed in a similar manner by multiplying the acreage of city wide parks (CTPA) by the average costs to maintain a city wide park acre (MC/CTPA).

$$CTPMC_{t+1} = CTPA_{t+1} * MC/CTPA_{p} \tag{PR-21}$$

The total park maintenance costs (PMC) are calculated in equation PR-22 by adding the maintenance costs for neighborhood, community and city, wide parks.

$$PMC_{t+1} = NPMC_{t+1} + CMPMC_{t+1} + CTPMC_{t+1} \tag{PR-22}$$

Equation PR-23 calculates the maintenance costs for pedestrian and cycling paths (PCPMC). This is computed by multiplying the pedestrian and cycling path footage (PCPF) by the average cost per lineal foot (MC/PCP).

$$PCPMC_{t+1} = PCPF_{t+1} * MC/PCP_{p} \tag{PR-23}$$

The City of Fairfield collects a fee from developers for the planting of street trees at the time the building permits are issued. The City must bear the cost for street tree planting (STPC). This cost is computed in equation PR-24 where ΔST is the number of new street trees required (from equation PR-43) and PC/ST is the cost of planting a street tree.

$$STPC_{t+1} = \Delta ST_{t+1} * PC/ST_p \qquad \text{(PR-24)}$$

The maintenance costs for street trees are calculated on the basis of the total number of street trees (ST). This total is computed in equation PR-25 by adding the number of new street trees (ΔST) to the number of street trees existing in the previous period.

$$ST_{t+1} = ST_t + \Delta ST_{t+1} \qquad \text{(PR-25)}$$

The street tree maintenance cost (STMC) is computed by multiplying the number of street trees and the average cost to maintain each tree (MC/ST).

$$STMC_{t+1} = ST_{t+1} * MC/ST_p \qquad \text{(PR-26)}$$

The maintenance costs for street median plantings (MPMC) is calculated as a function of the total lane miles of arterial streets (LMT). This is computed by multiplying the total arterial lane miles and the maintenance costs for median plantings

per lane mile (MP/LM).

$$MPMC_{t+1} = LMT_{4,t+1} * MP/LM_p \tag{PR-27}$$

The maintenance cost for parking lot landscaping (PLMC) is computed in equation PR-28 by multiplying the number of parking lots and the average maintenance cost per lot (MC/PL). For the present, it is assumed that the number of parking lots (PL) will not change, however, this is subject to user intervention.

$$PLMC_{t+1} = PL_p * MC/PL_p \tag{PR-28}$$

Equation PR-29 computes the total maintenance costs for the Parks Division (PDMC). This is calculated as the sum of the park maintenance costs (PMC) the pedestrian and cycling path maintenance costs (PCPMC), the cost of planting street trees (STPC), the maintenance costs for street trees (STMC), the maintenance costs for arterial street median plantings (MPMC), and parking lot landscaping (PLMC), and the maintenance cost for landscaping around public buildings such as the civic center (BLMC).

$$PDMC_{t+1} = PMC_{t+1} + PCPMC_{t+1} + STPC_{t+1} + STMC_{t+1} + MPMC_{t+1} + PLMC_{t+1} + BLMC_p \tag{PR-29}$$

The administrative costs for the Parks Division (PDAC) are calculated on the basis of total population where AC/POP

represents the average administrative costs. In the following equation GNCOC this parameter representing the general non-classified operating costs. This parameter is provided to allow for special costs which are not elsewhere classified. Initially, the value of this parameter is set as zero, but may be changed as necessary by user intervention.

$$PDAC_{t+1} = (TOTFN_{t+1} * AC/POP_p) + GNCOC_p \qquad (PR-30)$$

The total costs for the Parks Division (PDTC) is calculated in the following equation as the sum of the maintenance costs (PDMC) and the administrative costs (PDAC).

$$PDTC_{t+1} = PDMC_{t+1} + PDAC_{t+1} \qquad (PR-31)$$

Operating Costs

The Recreation Department is responsible for the operation of all recreation facilities, including the maintenance of the swimming pools. For simplicity it is also assumed that the maintenance costs of special facilities such as stadia and community centers are included in the operating costs of these facilities.

The operating costs of swimming pools (SPOC) is calculated in equation PR-32. In the following equation SWMP represents the number of swimming pools (from equation PR-6) and OC/SP is the average operating costs for each pool.

$$SPOC_{t+1} = SWMP_{t+1} * OC/SP_p \quad \text{(PR-32)}$$

The operating costs for special facilities (SFOC) is calculated in a similar manner by multiplying the number of special facilities (SF) by the average annual costs to operate these facilities (OC/SF).

$$SFOC_{t+1} = SF_{t+1} * OC/SF_p \quad \text{(PR-33)}$$

The total operating costs for the Recreation Department (RDOC) include the cost for general recreation programs, such as playgroung supervision, city-wide sports teams, and recreation classes, and the operating costs for various facilities such as swimming pools and community centers. In the following equation, general recreation costs are calculated by multiplying the average recreation costs per person (RC/POP) by the total city population (TOTFN). This product is then added to the operating costs for swimming pools (SPOC) and special facilities (SFOC).

$$RDOC_{t+1} = (TOTFN_{t+1} * RC/POP_p) + POC_{t+1} + SFOC_{t+1} \quad \text{(PR-34)}$$

Equation PR-35 calculates the administrative costs for the Recreation Department (RDAC). These costs are computed on the basis of population by multiplying the total population (TOTFN)

by the average administrative costs per person (RAC/POP).

$$RDAC_{t+1} = TOTFN_{t+1} * RAC/POP_p \qquad \text{(PR-35)}$$

The total costs for the Recreation Department (RDTC) are calculated by adding the operating costs (RDOC) and the administrative costs (RDAC).

$$RDTC_{t+1} = RDOC_{t+1} + RDAC_{t+1} \qquad \text{(PR-36)}$$

The total operating costs for the Parks and Recreation Subsystem (PROC) include the total costs of the Parks Division (PDTC) and the total costs of the Recreation Department (RDTC). This is calculated in equation PR-37 below.

$$PROC_{t+1} = PDTC_{t+1} + RDTC \qquad \text{(PR-37)}$$

The total costs for the entire parks and recreation function of the City of Fairfield (PRTC) is the sum of the capital costs for parks development (PRCC) and the annual operating costs (PROC) from equation PR-37.

$$PRTC_{t+1} = PRCC_{t+1} + PROC_{t+1} \qquad \text{(PR-38)}$$

Recreation Revenue

At the time that building permits are issued, all developers must pay a fee for the installation of street trees and the

development of park and recreation facilities. In addition, residential developments in the Cordelia planning area must pay a park dedication fee for development of community parks. The Recreation Department also collects fees from participants in the City's recreation programs, and the users of the swimming pools and golf courses.

<u>Street Tree Revenue</u>

As noted earlier, the City of Fairfield collects revenues for the implantation of street trees at the time of building permit issuance. Street tree revenues (STR) are based on the number of new street trees required (ΔST). The number of street trees required is a function of new street frontage. Equation PR-39 computes the amount of residential street frontage in feet for all one-, two-, three-, and four-lane roads. In this equation the lane footage is summed over all four types of streets where ΔRSF is the number of feet of new residential street frontage; $\Delta LFSF$ is the new lane-feet of residential streets in Fairfield; $\Delta LFRC$ is the new residential streets in Cordelia; RSOSF and RSOSC are the residential street oversizing in Fairfield and Cordelia, respectively; 2nd SF/LF is the ratio of street frontage to lane feet for each type of street. The subscript indicates the number of lanes for each type of street.

$$\Delta RSF_{t+1} = \sum_{Q=1}^{4} ((\Delta LFRF_{Q,t+1} + \Delta LFRC_{Q,t+1} + RSOSF_{Q,t+1} + RSOSC_{Q,t+1}) * SF/LF_{Q,p}) \qquad \text{(PR-39)}$$

Equation PR-40 calculates the amount of new commercial street frontage (ΔCSF). In this equation, $\Delta LFCF$ and $\Delta LFCC$ are the lane feet of new commercial streets in Fairfield and Cordelia, respectively; CSOSF and CSOSC are the oversized commercial streets in Fairfield and Cordelia, respectively; and SF/LF is again the set of specific ratios of street frontage to lane feet.

$$\Delta CSF_{t+1} = \sum_{Q=1}^{4} ((\Delta LFCF_{Q,t+1} + \Delta LFCC_{Q,t+1} + CSOF_{Q,t+1} + CSOSC_{Q,t+1}) * SF/LF_{Q,p}) \qquad (PR-40)$$

Equation PR-41 performs the same calculation for frontage of new industrial streets (ΔISF) in each planning area.

$$\Delta ISF_{t+1} = \sum_{Q=1}^{4} ((\Delta LFIF_{Q,t+1} + \Delta LFIC_{Q,t+1} + ISOF_{Q,t+1} + ISOSC_{Q,t+1}) * SF/LF_{Q,p}) \qquad (PR-41)$$

The total amount of new street frontage (ΔTSF) is calculated as the sum of the frontage from residential, commercial, and industrial streets.

$$\Delta TSF_{t+1} = \Delta RSF_{t+1} + \Delta CSF_{t+1} + \Delta ISF_{t+1} \qquad (PR-42)$$

Equation PR-43 estimates the number of street trees needed as a function of the parametric ratio of street trees to feet of street frontage (ST/FSF) and amount of new street tree frontage.

$$\Delta ST_{t+1} = \Delta TSF_{t+1} * ST/TSF_p \quad \text{(PR-43)}$$

The total revenues for street trees are then calculated in equation PR-44 by multiplying the number of new trees by the parametric street tree fee (STF).

$$STR_{t+1} = \Delta ST_{t+1} * STF_p \quad \text{(PR-44)}$$

Park Development Fee

The City of Fairfield collects a special fee for the development of park and recreation facilities. The revenues from this special fee are based on the number of bedrooms in each housing unit. There is a flat fee ($225) for the first bedroom in a dwelling unit and an incremental fee ($72.50) for each additional bedroom. In addition, a special bedroom related fee is collected for development of community parks in the Cordelia planning area.

The CRIS Model divides housing units into six categories. The categories are determined by the type of housing unit, i.e., single family or multi-family and the number of bedrooms contained within the housing type. The six housing categories are outlined in Table PR-1 below.

TABLE PR-1

Housing Categories

Housing Category	Housing Type	Number of Bedrooms
1	Single Family	2
2	Single Family	3
3	Single Family	4+
4	Multi-Family	0-1
5	Multi-Family	2
6	Multi-Family	3+

In the model, the number of newly constructed housing units is taken directly from the development schedules for each planning area. The new housing units in the Fairfield planning area are represented by the mnemonic ΔHUTF and ΔHUTC represents the new units in the Cordelia planning area. The category of housing unit corresponding to those in Table PR-1 is identified by the first mnemonic subscript.

The special revenues for development of park and recreation facilities in the Fairfield planning area are a function of the flat fees (PRBFF) and incremental fees (PRBIF) for the bedrooms in each category of housing unit. The parks and recreation special revenues (PRSRF) are computed for each housing category in equations PR-45 through PR-50. Again the housing category is identified by the first subscript to the mnemonic.

$$PRSRF_{1,t+1} = \Delta HUTF_{1,t+1} * (PRBFF_p + PRBIF_p) \qquad \text{(PR-45)}$$

$$PRSRF_{2,t+1} = \Delta HUTF_{2,t+1} * ((PRBFF_p + (2 * PRBIF_p)) \qquad \text{(PR-46)}$$

$$PRSRF_{3,t+1} = \Delta HUTF_{3,t+1} * ((PRSFF_p + (3 * PRBIF_p)) \qquad (PR-47)$$

$$PRSRF_{4,t+1} = \Delta HUTF_{4,t+1} * PRBFF_p \qquad (PR-48)$$

$$PRSRF_{5,t+1} = \Delta HUTF_{5,t+1} * (PRBFF_p + PRBIF_p) \qquad (PR-49)$$

$$PRSRF_{6,t+1} = \Delta HUTF_{6,t+1} * ((PRBFF_p + (2 * PRBIF_p)) \qquad (PR-50)$$

An identical fee applies in the Cordelia planning area. Cordelia's special revenue for parks and recreation (PRSRC) is calculated in equations PR-51 through PR-56.

$$PRSRC_{1,t+1} = \Delta HUTC_{1,t+1} * (PRBFF_p + PRBIF_p) \qquad (PR-51)$$

$$PRSRC_{2,t+1} = \Delta HUTC_{2,t+1} * ((PRBFF_p + (2 * PRBIF_p)) \qquad (PR-52)$$

$$PRSRC_{3,t+1} = \Delta HUTC_{3,t+1} * ((PRBFF_p + (3 * PRBIF_p)) \qquad (PR-53)$$

$$PRSRC_{4,t+1} = \Delta HUTC_{4,t+1} * PRBFF_p \qquad (PR-54)$$

$$PRSRC_{5,t+1} = \Delta HUTC_{5,t+1} * (PRBFF_p + PRBIF_p) \qquad (PR-55)$$

$$PRSRC_{6,t+1} = \Delta HUTC_{6,t+1} * ((PRBFF_p + (2 * PRBIF_p) \qquad (PR-56)$$

Equation PR-57 computes the total parks and recreation special revenue (PRSRT) as the sum of the revenues from the six housing categories for both the Fairfield and Cordelia planning areas.

$$PRSRT_{t+1} = \sum_{k=1}^{6} (PRSRF_{k,t+1} + PRSRC_{k,t+1} \qquad (PR-57)$$

The special fee for development of community parks in the Cordelia planning area is also levied on the basis of the number of bedrooms in the dwelling unit. The revenues from this community park fee (CMPRC) are calculated in equations PR-58 through PR-63,

where $\Delta HUTC$ is the number of new dwelling units in Cordelia, CMPFF is the community park flat fee, and CMPIF is the incremental fee based on the number of bedrooms exceeding one per unit.

$$CMPRC_{1,t+1} = \Delta HUTC_{1,t+1} * (CMPFF_p + CMPIF_p) \tag{PR-58}$$

$$CMPRC_{2,t+1} = \Delta HUTC_{2,t+1} * ((CMPFF_p + (2 * CMPIF_p)) \tag{PR-59}$$

$$CMPRC_{3,t+1} = \Delta HUTC_{3,t+1} * ((CMPFF_p + (3 * CMPIF_p)) \tag{PR-60}$$

$$CMPRC_{4,t+1} = \Delta HUTC_{4,t+1} * CMPFF_p \tag{PR-61}$$

$$CMPRC_{5,t+1} = \Delta HUTC_{5,t+1} * (CMPFF_p + CMPIF_p) \tag{PR-62}$$

$$CMPRC_{6,t+1} = \Delta HUTC_{6,t+1} * ((CMPFF_p + (2 * CMPIF_p)) \tag{PR-63}$$

The total community park development fees for Cordelia (CMPRT) calculated in equation PR-64 by summing the revenues across all types of dwelling units.

$$CMPRT_{t+1} = \sum_{u=1}^{6} CMPRC_{u,t+1} \tag{PR-64}$$

Equation PR-65 computes the revenues from fees for general recreation programs (RFR). This is calculated on the basis of program participation by assuming that participation is a function of population. In the following equation, TOTFN represents the total population of Fairfield and RF/POP is the average per capita recreation fee.

$$RFR_{t+1} = TOTFN_{t+1} * RF/POP_p \tag{PR-65}$$

Swimming pool revenue (SPR) is computed on the basis of the number of swimming pools. In the following equation SPR/SP is the average annual revenue per swimming pool and SWMP is the total number of pools (from equation PR-6).

$$SPR_{t+1} = SWMP_{t+1} * SPR/SP_{p} \tag{PR-66}$$

The total revenue from recreation programs and facilities (RRT) is computed in equation PR-67 by adding the revenues from general recreation fees (RFR) and swimming pools (SPR).

$$RRT_{t+1} = FRF_{t+1} + SPR_{t+1} \tag{PR-67}$$

The total revenue of the Recreation Department (RCTR) is calculated as the sum of the street tree revenue (STR), the special revenues for development of parks and recreation facilities (PRSRT), the fees for development of community parks in Cordelia (CMPRT), and the total recreation revenue (RRT).

$$RCTR_{t+1} = STR_{t+1} + PRSRT_{t+1} + CMPRT_{t+1} + RRT_{t+1} \tag{PR-68}$$

GENERAL GOVERNMENT

General government subsystem models the general and administrative expenses not accounted for by any of the other CRIS model subsystems.[1] Basically, the general government subsystem considers those important municipal functions which are not directly related to the type or rate of development in the city. For simplicity, the definition of general government used here, except where specifically noted, is that accepted for the annual report of the State Controller.[2]

This includes the following categories of expenditure:

1. City Council
2. City Manager's Office
3. City Clerk
4. Finance Department
5. City Treasurer
6. City Attorney
7. Planning Department

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[1]This subsystem was prepared with the assistance of Caj Falcke from the David M. Dornbusch & Company (consultant), Dr. Earl Bossard, from San Jose State University, and Ned Honig, formerly with the ABAG staff.

[2]California State Controller Annual Report of Financial Transactions Concerning Cities of California, published annually.

8. Personnel Administration
9. General Government Buildings
10. Debt Service
11. Retirement
12. Insurance
13. Community Promotion
14. Elections

Many complex factors can affect the level of general government expenditure in a growing city such as Fairfield.[3] Among these factors are the historic levels and range of general government services, the historic size of the central management personnel, the age structure and seniority level of general government workers, the historic growth rate of the community, efficiency of personnel management, and the magnitude of expected future growth.

[3]Considerable research on this topic has been done by the Center for Urban Policy Research at Rutgers University and the Institute of Government and Public Affairs at the University of California at Los Angeles. For more detailed discussions see George Sternlieb et. al, Housing Development and Municipal Costs, specifically Chapter 4 entitled Public Sector: The Impact of Population Change on Municipal Expenditure Levels, Chapter 5 Municipal Expenditures as a Function of Growth Rates, and Chapter 6 Forces Other than Growth Affecting Per Capita Costs. Werner Z. Hirsch has examined many of the theoretorical issues associated with local government expenditures. His most relevant works include the economics of State and Local Governments and Urban Economics Analysis.

Thus, it is extremely difficult to establish a predictive function which is capable of accurately estimating changes in general government expenditures as a result of changes in development. After considerable analysis, it was determined that the expenditures (excluding debt service and retirement expenses) are best estimated as a function of the total city retirement expenses) are best estimated as a function of the total city population. However, before accepting this conclusion it is useful to briefly review the nature and extent of the analysis which lead to it.

The first attempt to develop a general government function used correlation and regression analysis of time series data (past Fairfield budgets). Most of the correlations were insignificant but several conclusions could be made on the use of this data.

- Significant changes in the nature of the local government fiscal system in California over the past several years make it difficult to project on the basis of post fiscal data.
- It is anticipated that the nature of Fairfield past expenditures will change significantly as a result of a development as large as the Cordelia area.
- Changes in budgetary and other fiscal reporting systems in the City of Fairfield created insurmountable statistical problems with the time series analysis.

The second major effort involved correlation analysis on cross sectional data consisting of other cities in the San Francisco Bay Area (92 cities). Necessarily, the study was confined to the fiscal data available in the State Controller's reports.[4] Therefore, the definition of general government expenditures was limited to that used in the Controller's publication, including retirement and debt service expenditures.

The following results were obtained from the cross sectional regressions:

- No significant correlation was found between general government expenditure and population growth rate for any social or economic variables other than total population.
- A moderate correlation was found between total population and general government expenditures.
- High correlations were found between general government expenditures and most revenue categories including total revenues.
- High correlations were also found between general government expenditures and several other categories of expenditure, however the general government expenditures were more highly correlated with revenues than with specific expenditure categories.

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[4] California State Controller, <u>on</u> <u>cit.</u>

Because of the high correlation between general government expenditures and revenues, a regression was run relating these expenditures to total revenues. For comparative purposes, two additional regression equations were developed. The first, a multi-variate regression considered general government expenditures to be a function of both population and assessed valuation. The second, a simple regression, used non-general government expenditures as the independent variable.

The three regression equations are shown below. The standard errors for each independent variable are shown in parenthesis.

General Government Expenditures = -1,698,272 + .56 Total Revenue
(.006) (GG-1)

$N = 92$, $F = 8{,}532.68$, $R^2 = .98$

General Government Expenditures = -6,910,798 - 454.3 Population
(77.4)
+ .24 Assessed Value
(.026) (GG-2)

$N = 92$, $F = 219.58$, $R^2 = .98 = .831$

General Government Expenditures = -3,194,415
+ 1.4 Non-General Government Expenditures
(.035) (GG-3)

$N = 92$, $F = 1{,}514.40$, $R^2 = .94$

The three regression equations appear to demonstrate a strong relationship between the dependent variable (general government expenditures) and the independent variables. All three equations were applied to Fairfield data for fiscal years 1965-66 and 1972-73 to determine how well they predicted the actual general government expenditures for those years. The equation with general government expenditures as a function of population and assessed valuation (GG-2) was tested using both the total population of Fairfield and the population exclusive of Travis Air Force Base.

The results of the tests are presented in Table GG-1 and summarized below:

TABLE GG-1

RESULTS OF CROSS-SECTIONAL REGRESSION TESTS

CITY OF FAIRFIELD - FISCAL YEARS 1965/66, 1972/73

YEAR	Actual General Government Expenditures (dollars)	Equation GG-1 Predicted (dollars)	Equation GG-2 Predicted (w/Travis) (dollars)	Equation GG-3 Predicted (w/Travis) (dollars)	Equa GC Prec (dol
1972-73	1,433,347	1,505,601	-12,567,355	-6,661,823	2,39
1965-66	349,660	-577,182	-19,018,252	-11,364,205	-1,41

- The equation relating general government expenditures to total revenue predicted the actual general government expenditures for Fairfield in fiscal year 1972-73 with an error of only 5%. Actual general government expenditures were $1.43 million and predicted expenditures were $1.51 million.

- The equation relating general government expenditures to non-general government expenditures predicted the general government expenditures with an error of 67%. The predicted expenditures for general government for this equation were $2.39 million.

- The equation relating general government expenditures to population and assessed valuation predicted a negative value for general government expenditures in fiscal year 1972-73.

- All equations predicted negative values for general government expenditures for fiscal year 1965-66.

It was hypothesized that negative results could be eliminated if the regressions were developed only from data on cities in Fairfield's current and anticipated population range (40,000 to 100,000). However, the predicted degree of the functions were not significantly improved as a result of this analysis.

The fact that the equation relating total revenues to general government expenditures for Fairfield with an error of only 5%. It should not be considered as an indication of the accuracy of this equation for projection purposes.[5]

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[5] If general government expenditures had been regressed against total expenditures, the resulting equation would have been virtually the same as the equation relating general government expenditures to total revenue. Total expenditures, of course, tend to match total revenues. From our analysis, the correlation between total revenues and total expenditures was practically 1.00.

In the course of this analysis, it became evident that total revenues, may to a considerable extent, predetermine total expenditures. In other words, the level of total expenditures is largely determined by the amount of money that is available to spend. However, this conclusion is of little use in predicting both revenue and expenditures.

A possible hypothesis may be that most revenue sources cannot be influenced significantly on a year-to-year basis by a City Council or City Administration. Property taxes account for approximately 26% of the total city revenues throughout the State, and approximately 20% of Fairfield's revenues. Because of political factors and legal limits on the property tax rate, city decision-makers have little leeway to vary property tax rates and thus property tax revenues in the short term. If this hypothesis is valid, then total general government expenditures generated by a new project may simply be a function of the total revenues generated by that project. However, the percentage of total revenue spent for each specific service category (e.g., police, fire, streets and parks) could still vary with the type of development and the social and economic characteristics of the population independent of the revenues that are generated.

It was obvious from the foregoing analysis that a major factor interfaced with the correlations and prevented estab-

lishment of useful predictive coefficients through the regression analysis. This factor was the inclusion of debt service in the general government expenditures. The third effort, then, was to develop a general government function, excluding debt service expenses.

The budgets for the City of Fairfield from fiscal year 1970-71 through fiscal year 1977-78 were examined. The purpose of the examination was to establish a stable relationship between a known or estimable quantity and those general government expenditures which so far remain unestimated in the CRIS Model. The approach here was, of course, time series analysis. The data presented in Table GG-2 is taken from these budgets.

The table clearly shows a break in the budgeting trend and possibly in the level of city services between fiscal year 1972-73 and fiscal year 1973-74. It was therefore considered appropriate to avoid basing future projections on data prior to fiscal year 1973. Unfortunately, this left very few data points from which to conduct the subsequent analysis. However, this limitation did not, in fact, present a problem.

Two separate analyses were performed. General government expenditures were compared to population and the results of this analysis is shown in Figure GG-1. The second analysis compared general government expenditures to total operating budgets excluding all general government costs of debt service.

TABLE GG-2
CITY OF FAIRFIELD - APPROVED BUDGET
FISCAL YEARS

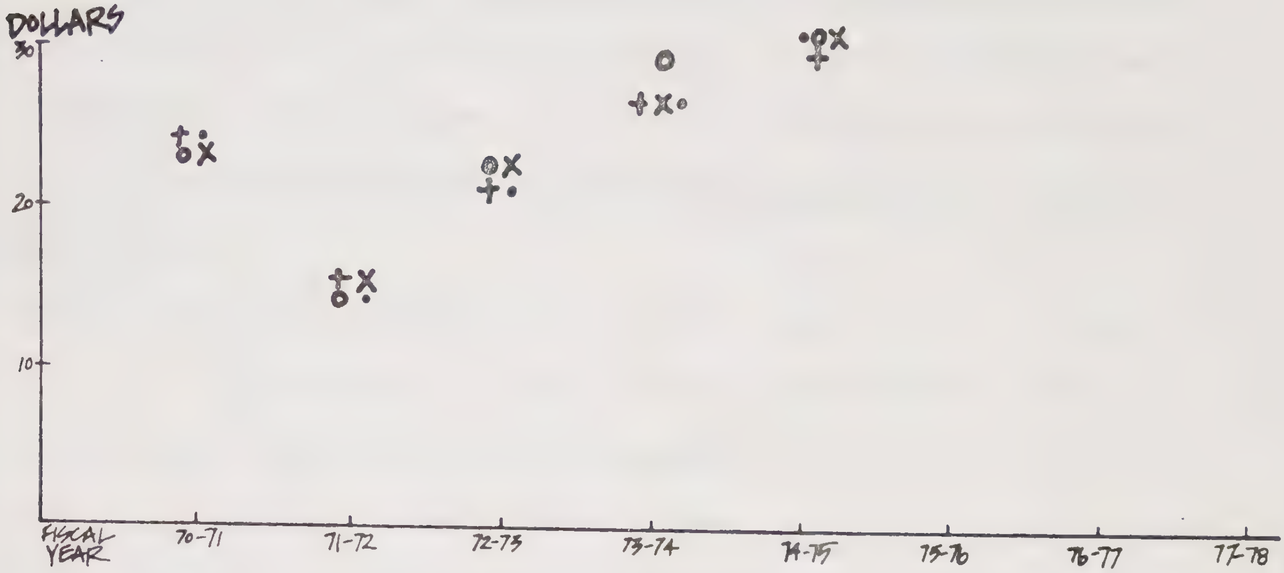
	1970-71	71-72	72-73	73-74	74-75	75-76	76-77	77-78
General Gov't	376 337	418 609	541 891	413 903	519 129	637 687	749 126	839 235
Public Safety	71 986	74 882	86 257	102 880	136 669	166 669	151 810	172 744
Engineering & Admin.	214 359	197 817	276 876	298 606	359 920	380 574	388 816	428 657
Administrative Service	NR[1]	NR	NR	416 250	585 573	683 036	786 385	913 018
Misc.	181 433	197 189	353 678	40 525	NR	NR	NR	NR
Total "General Fund"	844 114	564 087	907 424	1272 164	1601 291	1867 435	2076 237	2353 654
Deflated to 1975 Value	1121 001	708 652	1077 701	1394 917	1601 291	NC[2]	NC	NC
Total Operating Budget w/o debt service	5680 147	4447 957	6265 055	5270 562	5914 826	6121 174	6984 421	7350 810
Deflated to 1975 Values	7543 356	5587 886	7440 683	5779 125	5914 826	NC	NC	NC
Debt Service	874 173	681 137	773 287	446 118	600	336 296	340 680	600

[1] NR - not reported due to change in budgeting procedures

[2] NC - not calculated

FIGURE GG1

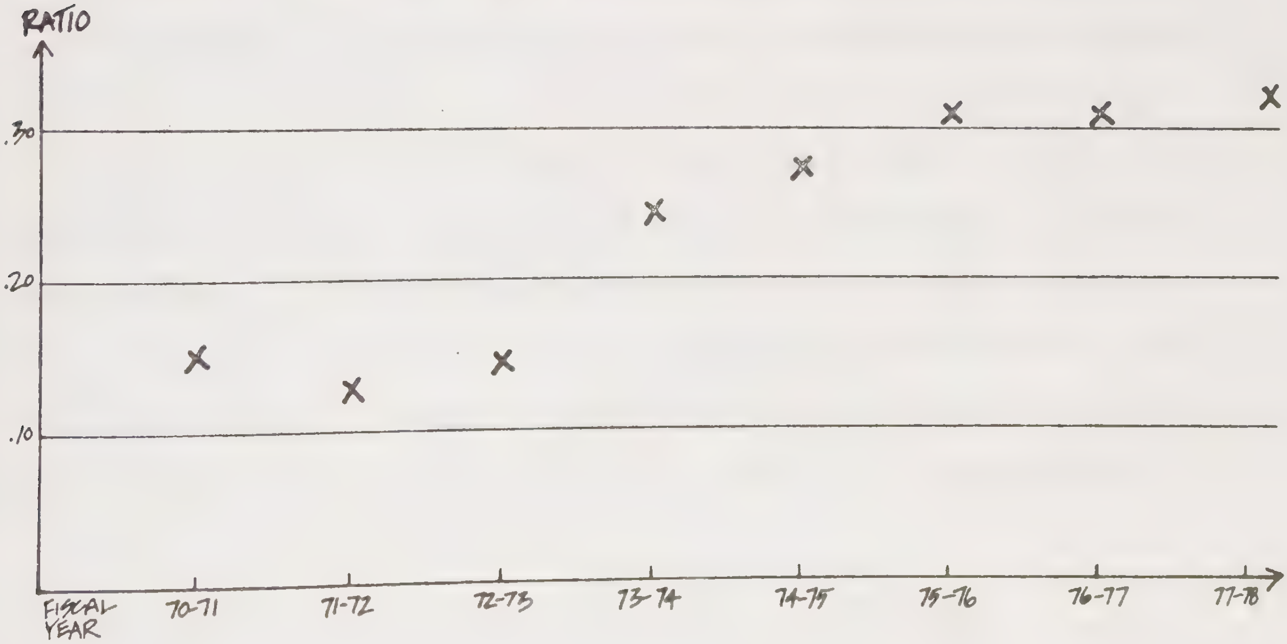
GENERAL GOVERNMENT EXPENDITURES (IN 1974-75 DOLLARS) PER CAPITA



O POPULATION LAGGED 2 YEARS
X POPULATION LAGGED 1 YEAR
• CURRENT POPULATION
+ POPULATION LEADED 1 YEAR

FIGURE GG2

GENERAL GOVERNMENT EXPENDITURES PER OTHER EXPENDITURES EXCLUDING DEBT SERVICE



The results of this analysis was shown in Figure GG-2. From the second figure, it appears that general government expenditures are approaching a certain constant proportion of the total operating budget. Indeed a curvalinear regression of the following form, even with so few sample points, (degrees of freedom = three) is highly significant and stable.

$$Y = \alpha - \beta(1/t) \tag{GG- 4}$$

where: Y = ratio of General Government Expenditures to all other expenditures (Total Operating Budget) excluding debt service, and

t = time such that FY 73-74 equals 1, FY 74-75 equals 2, and so forth.

The regression coefficients are $\alpha = .329$ and $\beta = .029$ with standard errors of .009 and .017 respectively; r^2 is .904 with a standard error of the entire model as low as .0001245. Thus, the ratio of general government expenditures to total operating budget is approaching its asymptotic value of .329 very rapidly at fiscal year 1977-78 (t=5). The quantity $\beta/5$ is already negligible (.006) in that year. Moreover, the estimated α is remarkably stable with a value that is more than 35 times its standard error.

Based on this analysis, it was recommended that the CRIS Model use the proportion .33 of non-general government expenditures (excluding debt service) as an estimate of general government expenditures.

Thus, the general form of the estimating equation is as shown in GG-5 below.

General Government Expenditures = .33 * Total Operating Budget (without debt service) (GG-5)

The first operation, then, is to calculate the total operating expenditures for all subsystems. In each case, the expenditures for the specific subsystems are exclusive of the costs for debt service. This is referred to as the non-general government operating budget (NGGOB).

The costs included in this calculation are only those for the City of Fairfield. The total cost of the school district is excluded although the maintenance costs for sewer pipes are considered.

In the following equation, the non-general government operating budget (NGGOB) is calculated as the sum of the costs for police (TPC), fire protection (FCT), sewer pipe maintenance (SPMC), operation of the water treatment plant and delivery system and construction of water pipes (WOMC and CCWP, respec-

tively), maintenance and construction of streets (STC), and parks and recreation (PRTC).

$$NGGOB_{t+1} = (TPC_{t+1} + FCT_{t+1} + WOMC_{t+1} + CCWP_{t+1} + STC_{t+1} + PRTC_{t+1}) \qquad \text{(GG-6)}$$

From this sum, the total general government expenditures (GGE) can be calculated. Equation GG-7 computes the general government expenditures by multiplying the non-general government expenditures by the regression determined coefficient and adding the cost of debt service on general obligation bonds passed subsequent to the Jarvis-Gann Amendment (PMTBJ).

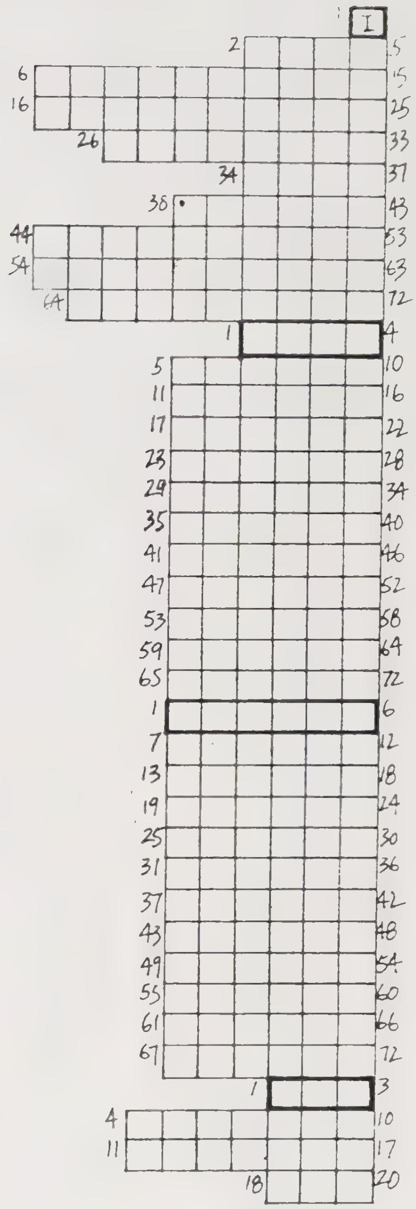
$$GGE_{t+1} = .33 * NGGOB_{t+1} + PMTBJ_{p,t+1} \qquad \text{(GG-7)}$$

Appendix A

DEVELOPMENT SCHEDULE (INDUSTRIAL)

Number	Description
1.	Type of Schedule
2.	Year
3.	Value (Light Industrial)
4.	Square Footage
5.	Acreage
6.	Number of Structures
7.	Employees
8.	Value (Heavy Industrial)
9.	Square Footage
10.	Acreage
11.	Number of Structures
12.	Employees
13.	Lane Feet (1 Lane)
14.	Lane Feet (2 Lanes)
15.	Lane Feet (3 Lanes)
16.	Lane Feet (4 Lanes)
17.	Sewer Pipe 6" Diameter (Lengths in Feet)
18.	Sewer Pipe 8" Diameter
19.	Sewer Pipe 10" Diameter
20.	Sewer Pipe 12" Diameter
21.	Sewer Pipe 16" Diameter
22.	Sewer Pipe 18" Diameter
23.	Sewer Pipe 24" Diameter
24.	Sewer Pipe 30" Diameter
25.	Sewer Pipe 36" Diameter
26.	Water Pipe 6" Diameter
27.	Water Pipe 8" Diameter
28.	Water Pipe 10" Diameter
29.	Water Pipe 12" Diameter
30.	Water Pipe 16" Diameter
31.	Water Pipe 18" Diameter
32.	Water Pipe 24" Diameter
33.	Water Pipe 30" Diameter
34.	Water Pipe 36" Diameter
35.	Number of Water Meters
36.	Sewer Usage (Gallons/Acre/Day)
37.	Water Usage (Gallons/Acre/Day)
38.	Planning District

Field



DEVELOPMENT SCHEDULE (RESIDENTIAL)

Number	Description	Field
1.	Type of Schedule	1
2.	Year	2
3.	Single Family Units 0-2 Bedrooms	6
4.	Average Value	10
5.	Square Footage	16
6.	Single Family Units 3 Bedrooms	20
7.	Average Value	24
8.	Square Footage	30
9.	Single Family 4+ Bedrooms	34
10.	Average Value	38
11.	Square Footage	44
12.	Total Acreage Single Family	48
13.	Multi-Family Units 0-1 Bedrooms	55
14.	Average Value	59
15.	Square Footage	65
16.	Multi-Family Units 2 Bedrooms	69
17.	Average Value	1
18.	Square Footage	7
19.	Multi-Family Units 3+ Bedrooms	11
20.	Average Value	15
21.	Square Footage	21
22.	Total Structures Multi-Family	25
23.	Total Acreage Multi-Family	30
24.	Lane Feet (1 Lane)	37
25.	Lane Feet (2 Lanes)	43
26.	Lane Feet (3 Lanes)	49
27.	Lane Feet (4 Lanes)	55
28.	Sewer Pipe 6" Diameter (Lengths in Feet)	61
29.	Sewer Pipe 8" Diameter	67
30.	Sewer Pipe 10" Diameter	1
31.	Sewer Pipe 12" Diameter	7
32.	Sewer Pipe 16" Diameter	13
33.	Sewer Pipe 18" Diameter	19
34.	Sewer Pipe 24" Diameter	25
35.	Sewer Pipe 30" Diameter	31
36.	Sewer Pipe 36" Diameter	37
37.	Water Pipe 6" Diameter	43
38.	Water Pipe 8" Diameter	49
39.	Water Pipe 10" Diameter	55
40.	Water Pipe 12" Diameter	61
41.	Water Pipe 16" Diameter	67
42.	Water Pipe 18" Diameter	1
43.	Water Pipe 24" Diameter	7
44.	Water Pipe 30" Diameter	13
45.	Water Pipe 36" Diameter	19
46.	Planning District	25

DEVELOPMENT SCHEDULE (COMMERCIAL)

Number	Description	Field
1.	Type of Schedule	1 C
2.	Year	2 – 5
3.	(Retail) Value	6 – 14
4.	Square Footage	15 – 22
5.	Acreage	23 – 28
6.	Employees	29 – 33
7.	Sales (Gross)	34 – 42
8.	Sales (Taxable)	43 – 51
9.	Number of Structures	52 – 55
10.	(Office) Value	56 – 64
11.	Square Footage	65 – 72
12.	Acreage	1 – 7
13.	Employees	8 – 14
14.	Sales (Gross)	15 – 23
15.	Sales (Taxable)	24 – 32
16.	Number of Structures	33 – 36
17.	Lane Feet (1 Lane)	37 – 42
18.	Lane Feet (2 Lanes)	43 – 48
19.	Lane Feet (3 Lanes)	49 – 54
20.	Lane Feet (4 Lanes)	55 – 60
21.	Sewer Pipe 6" Diameter (Lengths in Feet)	61 – 66
22.	Sewer Pipe 8" Diameter	67 – 72
23.	Sewer Pipe 10" Diameter	1 – 6
24.	Sewer Pipe 12" Diameter	7 – 12
25.	Sewer Pipe 16" Diameter	13 – 18
26.	Sewer Pipe 18" Diameter	19 – 24
27.	Sewer Pipe 24" Diameter	25 – 30
28.	Sewer Pipe 30" Diameter	31 – 36
29.	Sewer Pipe 36" Diameter	37 – 42
30.	Water Pipe 6" Diameter	43 – 48
31.	Water Pipe 8" Diameter	49 – 54
32.	Water Pipe 10" Diameter	55 – 60
33.	Water Pipe 12" Diameter	61 – 66
34.	Water Pipe 16" Diameter	67 – 72
35.	Water Pipe 18" Diameter	1 – 6
36.	Water Pipe 24" Diameter	7 – 12
37.	Water Pipe 30" Diameter	13 – 18
38.	Water Pipe 36" Diameter	19 – 24
39.	Number of Water Meters	25 – 27
40.	Sewer Usage (Gallons/Acre/Day)	28 – 34
41.	Water Usage (Gallons/Acre/Day)	35 – [illegible]
42.	Planning District	42 – 44

Appendix B

FIRE DATA

Base Data and Parameters not Updated by Model but May be Changed by the User

NAME	DESCRIPTION
FCCE	Capital cost of equipment
FCSS	Capital cost of substation
FCCR	Cost of crew
FMCS	Maintenance cost
FSOT	Minimum DUE to create ESSA
FSTD 11	Acreage standard zone 1
FSTD 12	Acreage standard zone 2
FSTD 13	DU standard zone 1
FSTD 21	DU standard zone 2
FSTD 22	DUE standard zone 1
FSTD 23	DUE standard zone 2

Base Data Updated by the Model Available for Each Year

NAME	DESCRIPTION
FINC 1	Increment for F standard zone 1
FINC 2	Increment for F standard zone 2
AAR 1	Available residential acreage zone 1
AAR 2	Available residential acreage zone 2
AAC 1	Available commercial acreage zone 1
AAC 2	Available commercial acreage zone 2
AAI 1	Available industrial acreage zone 1
AAI 2	Available industrial acreage zone 2

AAT 1	Available total acreage zone 1
AAT 2	Available total acreage zone 1
ADR 1	Developed acreage residential zone 1
ADR 2	Developed acreage residential zone 2
ADC 1	Developed acreage commercial zone 1
ACD 2	Developed acreage commercial zone 2
ADI 1	Developed acreage industrial zone 1
ADI 2	Developed acreage industrial zone 2
ADO 1	Developed acreage other zone 1
ADO 2	Developed acreage other zone 2
ADT 1	Developed acreage total zone 1
ADT 2	Developed acreage total zone 2

Computed for Each Year

NAME	DESCRIPTION
FCCT	Total capital costs
FCO	Total operating costs
FCT	Total costs

POLICE DATA

Base Data and Parameters not Updated by Model but May be Changed by the User

NAME	DESCRIPTION
SOKPOP	Sworn officers per 1000 population
SOFTS	Sworn officers/full time slot
SOVEH	Sworn officers/vehicle
XINVEH	Investigative personnel/vehicle
SPFTS	Support personnel/full time slot
SUPFTS	Supervisory personnel/full time slot
POEFTS	Operating expenses/full time slot
XNVFTS	Investigative personnel/full time slot
WRSO	Wage rate sworn officers
WRSP	Wage rate support personnel
WRI	Wage rate investigative personnel
WRS	Wage rate supervisory personnel
CPC	Cost of new vehicle
TIVV	Trade-in value/vehicle
PCAM	Patrol car average annual mileage
VIAM	Investigative vehicle average annual mileage
CPMM	Maintenance cost/mile
VCM	Vehicle operating cost/mile

Base Date Updated by the Model Available for Each Year

NAME	DESCRIPTION
EV	Number of existing patrol cars

EIV	Number of existing investigative vehicles
SO	Sworn officers (existing)
SP	Support personnel (existing)
SUP	Supervisory personnel (existing)
XINV	Investigative personnel (existing)

Computed for Each Year

NAME	DESCRIPTION
SCSO	Salary costs for sworn officers
SCSP	Salary costs for support personnel
SCINV	Salary costs for investigative personnel
SCSUP	Salary costs for supervisory personnel
TSC	Total salary costs
PCC	Vehicle capital costs
PCMC	Patrol car maintenance costs
IVMC	Investigative vehicle maintenance costs
CMP	Total vehicle maintenance costs
PCOC	Patrol cas operating costs
IVOC	Investigative vehicle operating costs
VOC	Total vehicle operating costs
POE	Department operating costs (other than salaries)
OC	Total operating costs
TPC	Total police costs

EDUCATION DATA

Base Data and Parameters not Updated by Model but May be Changed by the User

NAME	DESCRIPTION
BAV	Base year a.v. in district
PTRNB	Property tax rate (non-bond)
PRTB	Property tax rate (bond)
STD 1	Standard maximum capacity K-6
STD 2	Standard maximum capacity 7-8
STD 3	Standard maximum capacity 9-12
STDF 1	Standard square foot/pupil K-6
STDF 2	Standard square foot/pupil 7-8
STDF 3	Standard square foot/pupil 9-12
CPM	Transportation cost/pupil mile
BI	Bond interest rate (new)
CA	Cost/acre of land
CPP 1	Operating cost/pupil K-6
CPP 2	Operating cost/pupil 7-8
CPP 3	Operating cost/pupil 9-12
STDP 1	Standard core school capacity K-6
STDP 2	Standard core school capacity 7-8
STDP 3	Standard core school capacity 9-12
STDC 1	Construction cost/square foot K-6
STDC 2	Construction cost/square foot 7-8
STDC 3	Construction cost/square foor 9-12
AS 1	Standard acres/pupil K-6

AS 2	Standard acres/pupil 7-8
AS 3	Standard acres/pupil 9-12
REVP 1	Revenue/average daily attendence federal
REVP 2	Revenue/average daily attendance other state
REVP 3	Revenue/average daily attendance other
REVP 4	Basic equalization aid/average daily attendance
REVP 5	Foundation minimum K-8
REVP 6	Minimum tax rate K-8
REVP 7	Foundation minimum 9-12
REVP 8	Minimum tax rate 9-12

Base Data Updated by the Model Available for Each Year

NAME	DESCRIPTION
VCAP 11	Variable capacity zone 1 K-6
VCAP 12	Variable capacity zone 1 7-8
VCAP 13	Variable capacity zone 1 9-12
VCAP 21	Variable capacity zone 2 K-6
VCAP 22	Variable capacity zone 2 7-8
VCAP 23	Variable capacity zone 2 9-12
CAPMAX 11	Maximum capacity zone 1 K-6
CAPMAX 12	Maximum capacity zone 1 7-8
CAPMAX 13	Maximum capacity zone 1 9-12
CAPMAX 21	Maximum capacity zone 2 K-6
CAPMAX 22	Maximum capacity zone 2 7-8
CAPMAX 23	Maximum capacity zone 2 9-12
ENR 11	Enrollment zone 1 K-6
ENR 12	Enrollment zone 1 7-8

ENR 13	Enrollment zone 1 9-12
ENR 21	Enrollment zone 2 K-6
ENR 22	Enrollment zone 2 7-8
ENR 23	Enrollment zone 2 9-12
BTOT 1	Total buses Fairfield planning district
BTOT 2	Total buses Cordelia planning district

Computed for Each Year

FR	Federal revenue
OSR	Other state revenues
OR	Other revenues
PTNB	Revenues from property tax (non-bond)
PTB	Revenues from property tax (bond)
EQF	Revenues from equalization aid
TR	Total revenues
TOC	Total costs
BAL	Balance
CAPT	Capital costs (bond payments)
PORTC	Cost of new portables
BTO	Total new buses
PMTP	Principal payment for new bonds
PMTI	Interest payment for new bonds

DEMOGRAPHIC DATA

Base Data and Parameters not Updated by Model but May be Changed by the User

NAME	DESCRIPTION
PART 1	School participation rate K-6
PART 2	School participation rate 7-8
PART 3	School participation rate 9-12
SURV 1	Survival rates ages 1-4
SURV 2	Survival rates ages 5-12
SURV 3	Survival rates ages 13-14
SURV 4	Survival rates ages 15-18
SURV 5	Survival rates ages 18+
FERT	Fertility rate of females 15-44
XX	Number of females/100 15-44
AGE 11	Age proportion distribution single family 0-2 bedroom age 1-4
AGE 12	Age proportion distribution single family 0-2 bedroom age 5-12
AGE 13	Age proportion distribution single family 0-2 bedroom age 13-14
AGE 14	Age proportion distribution single family 0-2 bedroom age 15-18
AGE 15	Age proportion distribution single family 0-2 bedroom age 18+
AGE 21	Age proportion distribution single family 3 bedroom age 1-4

AGE 22	Age proportion distribution single family 3 bedroom age 5-12
AGE 23	Age proportion distribution single family 3 bedroom age 13-14
AGE 24	Age proportion distribution single family 3 bedroom age 15-18
AGE 25	Age proportion distribution single family 3 bedroom age 18+
AGE 31	Age proportion distribution single family 4+ bedroom age 1-4
AGE 32	Age proportion distribution single family 4+ bedroom age 5-12
AGE 33	Age proportion distribution single family 4+ bedroom age 13-14
AGE 34	Age proportion distribution single family 4+ bedroom age 15-18
AGE 35	Age proportion distribution single family 4+ bedroom age 18+
AGE 41	Age proportion distribution multi-family 0-1 bedroom age 1-4
AGE 42	Age proportion distribution multi-family 0-1 bedroom age 5-12
AGE 43	Age proportion distribution multi-family 0-1 bedroom age 13-14
AGE 44	Age proportion distribution multi-family 0-1 bedroom age 15-18

AGE 45	Age proportion distribution multi-family 0-1 bedroom age 18+
AGE 51	Age proportion distribution multi-family 2 bedroom age 1-4
AGE 52	Age proportion distribution multi-family 2 bedroom age 5-12
AGE 53	Age proportion distribution multi-family 2 bedroom age 13-14
AGE 54	Age proportion distribution multi-family 2 bedroom age 15-18
AGE 55	Age proportion distribution multi-family 2 bedroom age 18+
AGE 61	Age proportion distribution multi-family 3+ bedroom age 1-4
AGE 62	Age proportion distribution multi-family 3+ bedroom age 5-12
AGE 63	Age proportion distribution multi-family 3+ bedroom age 13-14
AGE 64	Age proportion distribution multi-family 3+ bedroom age 15-18
AGE 65	Age proportion distribution multi-family 3+ bedroom age 18+
GROW	Growth rate for Suisun
VRATE 1	Vacancy rate single family 0-2 bedroom
VRATE 2	Vacancy rate single family 3 bedroom
VRATE 3	Vacancy rate single family 4+ bedroom

VRATE 4	Vacancy rate multi-family 0-1 bedroom
VRATE 5	Vacancy rate multi-family 2 bedroom
VRATE 6	Vacancy rate multi-family 3+ bedroom
VTOT	Total vacancies
HHSIZE 1	Household size single family 0-1 bedroo
HHSIZE 2	Household size single family 3 bedroom
HHSIZE 3	Household size single family 4+ bedroom
HHSIZE 4	Household size multi-family 0-1 bedroom
HHSIZE 5	Household size multi-family 2 bedroom
HHSIZE 6	Household size multi-family 3+ bedroom
TRAVIS	Travis Air Force Base population

Base Data Updated by the Model Available for Each Year

NAME	DESCRIPTION
FPOP 11	Fairfield planning district age 1-4
FPOP 12	Fairfield planning district age 5-12
FPOP 13	Fairfield planning district age 13-14
FPOP 14	Fairfield planning district age 15-18
FPOP 15	Fairfield planning district age 18+
FPOP 21	Cordelia planning district age 1-4
FPOP 22	Cordelia planning district age 5-12
FPOP 23	Cordelia planning district age 13-14
FPOP 24	Cordelia planning district age 15-18
FPOP 25	Cordelia planning district age 18+
TEMPH 11	Vacant units (t-1) zone 1 single family 0-2 bedroom

TEMPH 12	Vacant units (t-1) zone 1 single family 3 bedroom
TEMPH 13	Vacant units (t-1) zone 1 single family 4+ bedroom
TEMPH 14	Vacant units (t-1) zone 1 multi-family 0-1 bedroom
TEMPH 15	Vacant units (t-1) zone 1 multi-family 2 bedroom
TEMPH 16	Vacant units (t-1) zone 1 multi-family 3+ bedrooms
TEMPH 21	Vacant units (t-1) zone 2 single family 0-2 bedroom
TEMPH 22	Vacant units (t-1) zone 2 single family 3 bedroom
TEMPH 23	Vacant units (t-1) zone 2 single family 4+ bedroom
TEMPH 24	Vacant units (t-1) zone 2 multi-family 0-1 bedroom
TEMPH 25	Vacant units (t-1) zone 2 multi-family 2 bedroom
TEMPH 26	Vacant units (t-1) zone 2 multi-family 3+ bedroom

Input from the Development Schedules

NAME	DESCRIPTION
HUT 11	New housing units (development schedule) zone 1 single family 0-2 bedroom

HUT 12	New housing units (development schedule) zone 1 single family 3 bedroom
HUT 13	New housing units (development schedule) zone 1 single family 4+ bedroom
HUT 14	New housing units (development schedule) zone 1 multi-family 0-1 bedroom
HUT 15	New housing units (development schedule) zone 1 multi-family 2 bedroom
HUT 16	New housing units (development schedule) zone 1 multi-family 3+ bedroom
HUT 21	New housing units (development schedule) zone 2 single family 0-2 bedroom
HUT 22	New housing units (development schedule) zone 2 single family 3 bedroom
HUT 23	New housing units (development schedule) zone 2 single family 4+ bedroon
HUT 24	New housing units (development schedule) zone 2 multi-family 0-1 bedroom
HUT 25	New housing units (development schedule) zone 2 multi-family 2 bedroom
HUT 26	New housing units (development schedule) zone 2 multi-family 3+ bedroom

Computed for Each Year

NAME	DESCRIPTION
TOT 1	Suisun population

TOT 2	Old Fairfield population
TOT 3	New population
SUMPOP 1	Total Suisun population
SUMPOP 2	Total old Fairfield population including Travis
SUMPOP 3	Total new population
SCHL 1	Total school enrollment K-6
SCHL 2	Total school enrollment 7-8
SCHL 3	Total school enrollment 9-12
SCHLN 11	New students zone 1 K-6
SCHLN 12	New students zone 1 7-8
SCHLN 13	New students zone 1 9-12
SCHLN 21	New students zone 2 K-6
SCHLN 22	New students zone 2 7-8
SCHLN 23	New students zone 2 9-12
POPN 11	New population zone 1 age 1-4
POPN 12	New population zone 1 age 5-12
POPN 13	New population zone 1 age 13-14
POPN 14	New population zone 1 age 15-18
POPN 15	New population zone 1 age 18+
POPN 21	New population zone 2 age 1-4
POPN 22	New population zone 2 age 5-12
POPN 23	New population zone 2 age 13-14
POPN 24	New population zone 2 age 15-18
POPN 25	New population zone 2 age 18+
HU 11	New housing units (less vacancies) zone 1 single family 0-2 bedroom

HU 12	New housing units (less vacancies) zone 1 single family 3 bedroom
HU 13	New housing units (less vacancies) zone 1 single family 4+ bedroom
HU 14	New housing units (less vacancies) zone 1 multi-family 0-1 bedroom
HU 15	New housing units (less vacancies) zone 1 multi-family 2 bedroom
HU 16	New housing units (less vacancies) zone 1 multi-family 3+ bedroom
HU 21	New housing units (less vacancies) zone 2 single family 0-2 bedroom
HU 22	New housing units (less vacancies) zone 2 single family 3 bedroom
HU 23	New housing units (less vacancies) zone 2 single family 4+ bedroom
HU 24	New housing units (less vacancies) zone 2 multi-family 0-1 bedroom
HU 25	New housing units (less vacancies) zone 2 multi-family 2 bedroom
HU 26	New housing units (less vacancies) zone 2 multi-family 3+ bedroom

CRIS